UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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STANDARD OPERATING PROCEDURE FOR SAMPLING POROUS SURFACES FOR POLYCHLORINATED BIPHENYLS (PCBs)

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STANDARD OPERATING PROCEDURE FOR SAMPLING POROUS SURFACES FOR POLYCHLORINATED BIPHENYLS (PCBs)

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Revision Page

Date	Rev#	Summary of Changes	Sections
12/97	1	Initial Approval, draft	
3/20/08	2	Major update, only for PCBs, added TSCA sampling	All sections
7/17/08	3	Disposal of dust filter and decon of vac hose	11.0 and 14.0
5/04/11	4	Vacuum Trap Design and Clean-out	9.4

Table of Contents

1.0 Scope and Application

1.1 This Standard Operating Procedure (SOP) is suitable for collection of a porous matrix sample for analysis of Polychlorinated Biphenyls (PCBs).

1.2 This SOP describes sampling techniques for both hard and soft porous surfaces.

1.2.1 Hard surfaces, and most soft surfaces, can be sampled using an impact hammer drill to generate a uniform, finely ground, powder to be extracted and analyzed for PCBs. This procedure is primarily geared at providing enough sample quantity for two analyses. Hard porous surfaces include concrete, brick, asphalt, cement, sandstone, limestone, unglazed ceramics, and other possible PCB suspected material. This procedure may also be used on other softer porous surfaces, such as wood.

1.2.2 Soft surfaces can be sampled using a chisel or sharp knife to generate a representative sample to be extracted and analyzed for PCBs. Soft porous surfaces include wood, wall plasterboard, low density plastics, rubber, caulking, and other PCB suspected material.

1.3 This SOP provides for collection of surface samples (0 – 0.5 inches) and delineation of PCB contamination throughout the core of the porous surface. The procedure can be used to sample the porous surface at distinctly different depth zones.

2.0 Method Summary

A one-inch or other sized diameter carbide drill bit is used in a rotary impact hammer drill to generate a fine powder, or other representative sample, suitable for extraction and analysis of PCBs from porous surfaces. This method also allows the use of chisels or knives for the collection of samples from soft porous surfaces for PCB analysis.

3.0 Definitions

3.1 Field/Bottle Blank: A sample container of the same lot as the containers used for the environmental samples. This evaluates PCB contamination introduced from the sample container(s) from a common lot.

3.2 Equipment/Rinse/Rinsate Blanks: A sample that is collected by pouring hexane over the sample collection equipment after decontamination and before sample collection. The sample is collected in the appropriate sample container identical to the sample containers. This represents background contamination resulting from the field equipment, sampling procedure, sample container, and shipment.

3.3 Field Replicates/Duplicates: Two or more samples collected at the same sampling location. Field replicates should be samples collected side by side. Field replicates represent the precision of the whole method, site heterogeneity, field sampling, and the laboratory analysis.

3.4 Field Split Samples: Two or more representative subsamples taken from one environmental sample in the field. Prior to splitting, the environmental sample is homogenized to correct for sample heterogeneity that would adversely impact data comparability. Field split samples are usually analyzed by different laboratories (interlaboratory comparison) or by the same laboratory (intralaboratory comparison). Field splits are used to assess sample handling procedures from field to laboratory and laboratory comparability.

3.5 Laboratory Quality Samples: Additional samples that will be collected for the laboratory's quality control program: matrix spike, matrix spike duplicate, laboratory duplicates, etc.

3.6 Proficiency Testing (PT)/Performance Evaluation (PE) Sample: A sample, the composition of which is unknown to the laboratory or analyst, provided to the analyst or laboratory to assess the capability to produce results within acceptable criteria. This is optional depending on the data quality objectives. If possible, it is recommended that the PE sample be of similar matrix as the porous surface(s) being sampled.

3.7 Porous Surface: Any surface that allows PCBs to penetrate or pass into itself including, but not limited to, paint or coating on metal; corroded metal; fibrous glass or glass wool; unglazed ceramics; ceramics with porous glaze; porous building stone such as sandstone, travertine, limestone, or coral rock; low density plastics such as Styrofoam and low density polyethylene; coated (varnished or painted) or uncoated wood; painted or unpainted concrete or cement; plaster; plasterboard; wallboard; rubber; caulking; fiberboard; chipboard; asphalt; or tar paper.

3.8 Shipping Container Temperature Blank: A water sample that is transported to the laboratory to measure the temperature of the samples in the cooler.

4.0 Health and Safety

4.1 Eye, respiratory, and hearing protection are required at all times during sample drilling. A properly fitted respirator is required for hard porous surface sampling. A respirator is recommended whenever there is a risk of inhalation of either particulate or volatilized PCBs during sampling.

4.2 All proper personal protection clothing and equipment must be worn.

4.3 When working with potentially hazardous materials or situations, follow EPA, OSHA, and specific health or safety procedures.

4.4 Care must be exercised when using an electrical drill and sharp cutting objects.

5.0 Interferences and Potential Problems

5.1 This sampling technique produces a finely ground uniform powder, which minimizes the physical matrix effects from variations in the sample consistency (i.e., particle size, uniformity, homogeneity, and surface condition). Matrix spike analysis of a sample is highly recommended to monitor for any matrix related interferences.

5.2 Nitrile gloves are recommended. Latex gloves must not be used due to possible phthalate contamination.

5.3 Interferences may result from using contaminated equipment, solvents, reagents, sample containers, or sampling in a disturbed area. The drill bit must be decontaminated between samples. (see Section 11.0.)

5.4 Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment.

6.0 Personnel Qualifications

6.1 All field samplers working at hazardous materials/waste sites are required to take a 40 hour health and safety training course prior to engaging in any field activities. Subsequently, an 8 hour refresher health and safety course is required annually.

6.2 The field sampler should be trained by an experienced sampler before initiating this procedure.

6.3 All personnel shall be responsible for complying with all quality assurance/quality control requirements that pertain to their organizational/technical function.

7.0 Equipment and Supplies

7.1 This list varies with the matrix and if depth profiling is required

Rotary impact hammer variable speed drill
1-inch or other suitable (1/2, 3/4, etc.) diameter carbide tip drill bits
Steel chisel or sharp cutting knife, and hammer
Brush and cloths to clean area
Stainless steel scoopulas

Aluminum foil to collect the powder sample
1 quart Cubitainer with the top cut out to collect the powder sample
Aluminum weighing pans to collect the powder sample
Cleaned glass container (2 oz or 40 mL) with Teflon lined cap
Decontamination supplies: hexane, two small buckets, a scrub brush, detergent, deionized water, hexane squirt bottle, and paper towels
Dedicated vacuum cleaner with a disposable filter or a vacuum pump with a dust filter
Polyethylene tubing and Pasteur pipettes
Sample tags/labels, custody seals, and Chain-of-Custody form

8.0 Sampling Design

8.1 A sufficient number of samples must be collected to meet the data quality objectives of the project. If the source of the PCB contamination is regulated under the federal TSCA PCB Regulations at 40 CFR Part 761, the sampler should insure that the sampling design is sufficient to meet any investigation or verification sampling requirements. At a minimum, the following is recommended:

8.1.1 Suspected stained area (s) should be sampled.

8.1.2 At each separate location, collect at least 3 samples of each type of porous surface, regardless of the amount of each type of porous surface present.

8.1.3 In areas where PCB equipment was used or where PCBs were stored, samples should be collected at a frequency of 1 sample/100 square feet (ft^2).

9.0 Sample Collection

9.1 Hard Porous Surfaces

9.1.1 Lock a 1-inch or another size diameter carbide drill bit into the impact hammer drill and plug the drill into an appropriate power source. For easy identification, sample locations may be pre-marked using a marker or paint. (Note: the actual drilling point must not be marked.) Remove any debris with a clean brush or cloth prior to drilling. All sampling decisions of this nature should be noted in the sampling logbook.

9.1.2 Use a Cubitainer with the top cut off or aluminum foil to contain the powdered sample. Begin drilling in the designated location. Apply steady even pressure and let the drill do the work. Applying too much pressure will generate excessive heat and dull the drill bit prematurely. The drill will provide a finely ground powder that can be easily collected.

9.1.3 Samples should be collected at ½-inch depth intervals. Thus, the initial surface sample should be collected from 0 – 0.5 inches. A ½-inch deep hole generates about 10 grams (20 mL) of powder. Multiple holes located closely adjacent to each other, may be needed to generate sufficient sample volumes for a PCB determination. It is strongly recommended that the analytical laboratory be consulted on the minimum sample size needed for PCB extraction and analysis.

9.1.4 Wall and Ceiling Sampling: A team of two samplers will be required for wall and ceiling sampling. The second person will hold a clean catch surface (e.g. an aluminum pan) below the drill to collect the falling powder. Alternatively, use the chuck-end of the drill bit and punch a hole through the center of the collection pan. The drill bit is then mounted through the pan and into the drill. For ceilings, the drill may be held at an angle to collect the powder. Thus the driller can be drilling at an angle while the assistant steadies the pan to catch the falling powder. As a precaution, it may be advantageous to tape a piece of plastic around the drill, just below the chuck, to avoid dust contaminating the body of the drill and entering the drill's cooling vents. Caution must be taken to prevent obstruction of the drill's cooling vents.

9.2 Soft Porous Surfaces

9.2.1 The procedure for the hard porous surface may be used for certain soft porous surfaces, such as wood.

9.2.2 Samples should be collected at no more than ½-inch depth intervals using a metal chisel or sharp cutting knife. Thus, the initial surface sample should be collected from 0 – 0.5 inches. It is important to collect at least 10 grams for analysis.

9.2.3 For soft porous surfaces, such as caulking and rubber, a representative sample can be collected using a metal chisel or sharp cutting knife.

9.3 Multiple Depth Sampling

9.3.1 Multiple Depth Sampling may not be applicable to certain porous surfaces, such as caulking.

9.3.2 Collect the surface sample as outlined in Section 9.1 or 9.2.

9.3.3 Use the vacuum pump or cleaner to clean out the hole.

9.3.4 To collect multiple depths there are two options.

9.3.4.1 Option one: drill sequentially ½-inch increments with the 1 inch drill.

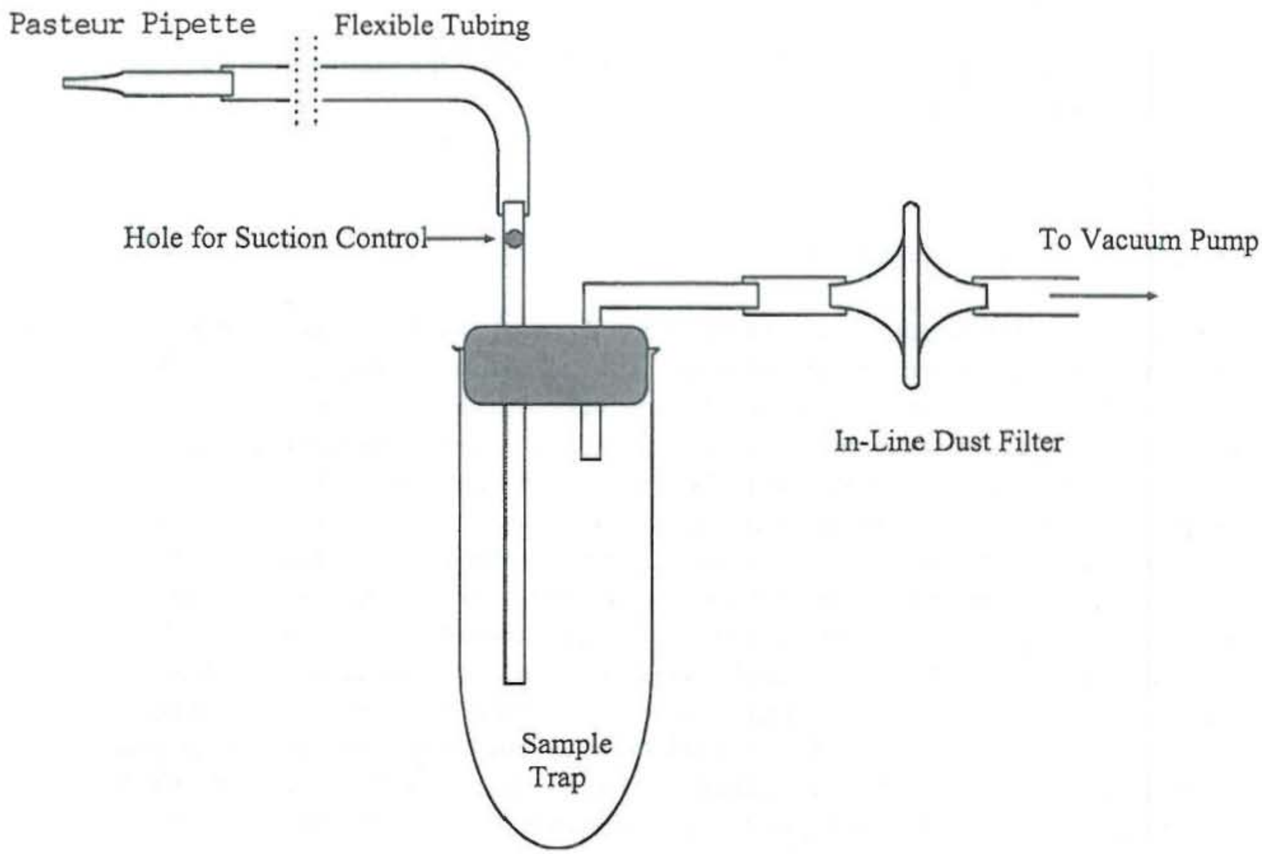
9.3.4.2 Option two: drill with the 1 inch bit and either make the hole larger or use a smaller bit to take the next ½- inch sample.

9.3.5 A stainless steel scoopula will make it easier to collect the sample from the bottom of the hole.

9.4 Vacuum Trap Design and Clean-out

The trap presented in Figure 1 is a convenient and thorough way for collecting and removing concrete powder from drilled holes. The trap system is designed to allow for control of the suction from the vacuum pump and easy trap clean-out between samples. Note, by placing a hole in the inlet tube (see Figure 1), a finger on the hand holding the trap can be used to control the suction at the sampling tip. Thus, when this hole is left completely open, there will be no suction, and the sampler can have complete control over where and what to sample. To change-out between samples the following steps should be taken: 1) the Pasteur pipette and piece of polyethylene tubing at the sample inlet should be replaced with new materials, 2) the portion of the rubber stopper and glass tubing that was in the trap should be wiped down with a clean damp paper towel (wetted with deionized water) and then dried with a fresh paper towel, 3) a clean pipe cleaner should be drawn through the glass inlet tube to remove any concrete dust present, and 4) the glass tube or flask used to collect the sample should swapped out with a clean decontaminated sample trap. Having several clean tubes or flasks on hand will facilitate change-out between samples.

Figure 1



Note: the holes should be vacuumed thoroughly to minimize any cross-contamination between sample depths and the bits should be decontaminated between samples. (See Section 11.0)

10.0 Sample Handling, Preservation, and Storage

10.1 Samples must be collected in glass containers for PCB analyses. In general, a 2-ounce sample container with a Teflon-lined cap (wide-mouth jars are preferred) will hold sufficient mass for most analyses. A 2-ounce jar can hold roughly 90 grams of sample.

10.2 Samples are to be shipped refrigerated and maintained at $\leq 6°C$ until the time of extraction and analysis.

10.3 The suggested holding time for PCB samples is 14 days to extraction.

11.0 Decontamination

11.1 Assemble two decontamination buckets. The first bucket contains a detergent and potable water solution, and the second bucket is for rinsate. Place all used drill bits, hose for the vacuum cleaner, and utensils in the detergent and water bucket. Scrub each piece thoroughly using the scrub brush. Note, the powder does cling to the metal surfaces, so care should be taken during this step, especially with the twists and curves of the drill bits. Next, rinse each piece with water and hexane. Place the rinsed pieces on clean paper towels and individually dry and inspect each piece. Note: all pieces should be dry prior to reuse.

11.2 Lightly contaminated drill bits and utensils may be wiped with a hexane soaked cloth and hexane rinsed for decontamination.

12.0 Data and Record Management

12.1 All data and information collection should follow a Field Data Management SOP or Quality Assurance Project Plan (QAPP).

12.2 Follow the chain of custody procedures to release the samples to the laboratory. A copy is kept with the sampling records.

12.3 The field data is stored for at least 3 years.

13.0 Quality Control and Quality Assurance

13.1 Representative samples are required. The sampler will evaluate the site specific conditions to assure the sample will be representative.

13.2 All sampling equipment must be decontaminated prior to use and between each discrete sample.

13.3 All field Quality Control (QC) sample requirements in a Sample and Analysis Plan (SAP) or QAPP must be followed. The SAP or QAPP may involve field blanks, equipment blanks, field duplicates and/or the collection of extra samples for the laboratory's quality control program.

13.4 Field duplicates should be collected at a minimum frequency of 1 per 20 samples or 1 per non-related porous matrix, whichever is greater.

14.0 Waste Management and Pollution Prevention

14.1 During field sampling events there may be PCB and/or hazardous waste produced from the sample collection. The waste must be handled and disposed of in accordance with federal, state, and local regulations. The dust filter, and tubing if a vacuum pump is used, is disposed after each site investigation. This waste will be treated as PCB waste if the samples are positive for PCBs. It may be possible to manage or dispose of the waste produced at the site where the work was performed. If the site does not meet regulatory requirements for these types of activities, the waste must be transported to a facility permitted to manage and/or dispose of the waste.

15.0 References

1. Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations, QA/G-6, EPA/600/R-96/027, November 1995.

2. 40 CFR Part 761 – Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, and Use Prohibitions

3. Sample Container and Holding Time: RCRA SW 846, Chapter 4, Table 4.1, Revision 4, February, 2007.

Example of Sample Label and Custody Seal

SAMPLE LABEL

U.S. ENVIRONMENTAL PROTECTION AGENCY – REGION I BOSTON, MASS.

NAME OF UNIT AND ADDRESS

ENVIRONMENTAL SERVICES DIVISION
60 WESTVIEW STREET
LEXINGTON, MASSACHUSETTS 02173

DATE: YR/MO/DAY

TIME

STATION NO.

SOURCE OF SAMPLE

SAMPLE NO.

SUB NO.

PRESERVATIVE

SAMPLING CREW(FIRST, INITIAL, LAST NAME)

AMOUNT

ANALYSIS

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
OFFICIAL SAMPLE SEAL

SAMPLE NO.

DATE

SIGNATURE

PRINT NAME AND TITLE *(Inspector, Analyst or Technician)*

SEAL BROKEN BY

DATE

EPA FORM 7500-2 (R7-75)

ENVIRONMENTAL PROTECTION AGENCY

REGION 1

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME					NO. OF CON-TAINERS							REMARKS
SAMPLERS: *(Signature)*													
STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION								

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

1-16940

☆ U.S. GOVERNMENT PRINTING OFFICE: 2004—750-325

Example of Chain of Custody Form

Project Operating Procedure

Recording of Field Data

Procedure Number: 001

Revision No.: 0

Revision Date: March 2010

Date: March 2010

Robert Shoemaker, POP Author

Date: March 2010

Lucas Hellerich, Project Manager

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________

Initials: ________ Date: ________

Contents

Project Operating Procedure

Recording of Field Data

1.0 Scope and Applicability

1.1 Purpose and Applicability

This Project Operating Procedure (POP) provides instructions for recording data when documenting a sample collection event, field measurements, or a site visit. Field data may be recorded in field logbooks, on standardized forms, as annotated maps, as photo documentation, or electronically. Chain-of-custody records are also considered field data; however, these records are specifically addressed in POP 002 Chain of Custody Procedures and POP 010 Packaging and Shipment of Environmental Samples.

2.0 Health and safety considerations

2.1 Not Applicable

3.0 Interferences

3.1 Not Applicable

4.0 Equipment and materials

The following materials are necessary for this procedure:

- Bound field logbook (preferably waterproof, such as Rite-in-Rain™)
- Standardized field data sheets (refer to individual POPs for test pit logs, boring logs, groundwater sample collection logs, etc.)
- Pen or SharpieTM
- Watch or other time-keeping device

The following materials may also be needed:

- Site maps
- Clipboard
- Three-ring binder or equivalent
- Camera

- Hand-held electronic recording device (e.g., PDA, laptop, or tablet PC)

5.0 Procedures

5.1 General

Field activities vary widely and no general rules can specify the exact information that must be recorded for each event. However, the field records must contain sufficient detail so that persons going to the site could reconstruct a particular situation without reliance on the collector's memory.

Field logbooks may be supplemented by standardized forms (e.g., well construction and development, sample collection forms, drum logs). In that case, the logbook provides a chronology of events, summary of personnel on site, and a narration of events not covered by the standardized forms. It is recommended that the details recorded on the standardized forms not be replicated in the logbook due to the potential for transcription errors and inconsistencies. References to standardized forms must be included in the logbook.

Entries will be recorded legibly in permanent ink (a black ballpoint pen is preferable) and will be signed and dated. No erasures or obliterations will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark which is initialed and dated by the sampler, and the correct information added.

Pencils should not be used. If a ballpoint pen cannot be used because of adverse weather conditions (rain or freezing temperatures), a fine-point Sharpie™ is an acceptable substitute. If conditions are such that only pencil can be used, an explanation must be included in the logbook and the affected data should be photocopied, signed as verified copy, and maintained in the project files as documentation that the data has not been changed.

Information to be recorded should address the questions of who, where, what, when, how, and why. A specific list of information that should be recorded is included in Table 1.

Entries will be objective, factual, and free of personal feelings or inappropriate language. Cryptic notes and undefined abbreviations or acronyms should be avoided.

Information will be made in as close to real time as possible. Information recorded significantly after the fact must be dated as such.

5.2 Field Logbooks

Field logbooks will be bound water-proof field survey books or notebooks with consecutively numbered pages.

Logbooks will be assigned to field personnel, and will be identified by a unique document number. The logbook should be kept in the field person's possession or in a secure location during field activities and archived in the project files upon completion of the field program.

Logbooks should be specific to a project. Multiple projects should not be included in one logbook because of document retention and evidentiary reasons.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned, AECOM office location, and phone number,
- The logbook number,
- Project name and number, and
- Start and end dates of work covered by the logbook.

Logbook entries documenting sample collection or field measurements must clearly identify the task being completed (for example, water level measurements, headspace readings). Units must be included for all measurements.

For ease of reference, it is recommended that a new page be started for each sampling day and that the time be recorded in the far left column. Each day's entries will be signed and dated by the person making the entries. A diagonal line across the bottom of the page will indicate the end of an entry.

5.3 Standardized Forms

- At a minimum, each form must include a title identifying the activity being documented and the project identification (name and number).
- Each form must be signed and dated by the person completing the form.
- There should be no blank spaces on the form. Each space must be filled in with the information requested or "NA" (not applicable).
- Forms should not be loose, but should be maintained in an organized manner (e.g., clipboards, binders).

5.4 Maps and Drawings

Maps and drawings that document final sampling locations and which are separate from the field logbook must be referenced in the logbook. These maps or drawings must include the project name and number, site identification and location, and must be signed and dated by the person recording the locations.

Maps and drawings must include compass orientation and scale.

5.5 Photographs and Other Photo Documentation

Photo documentation, if permitted at the site, can provide invaluable information on site conditions, sample locations, and the sample itself.

Photographs, videos, or slides must be cross-referenced to entries in the field logbook or on a photo documentation log. Information to be recorded includes name of photographer, date, time, direction faced, description of subject, and sequential number of the photograph and roll number. An indication of scale is also helpful. Image-enhancing techniques (lenses, film) should also be noted.

5.6 Electronic Files

Electronically captured data may include data logging systems and hand-held electronic recording devices such as PDAs, laptops, or tablet PCs.

Field data that is captured electronically must be cross-referenced in the field logbook. Information to be recorded includes the identity of the person recording the data, instrument make and model number, measurement time and date, and file identification.

Sufficient backup systems must be in place to protect against the loss of data. Electronic files must be saved to a disk or backed up immediately upon completion. The backup disk or other media (CD, flash drive) should then be stored in a secure location separate from the laptop, tablet, or PDA.

Files must be uniquely identified and should be stored in the project files on the network. An unedited version of the file must be maintained and all subsequent manipulations tracked.

6.0 Quality assurance / quality control

Field records provide evidence and support for technical decisions, interpretations, and judgments. It is therefore critical that procedures and systems be in place to ensure that they are legible, identifiable, and retrievable, and protected from loss or damage. In addition, client or regulatory requirements, or the end use of the data (e.g., to support litigation) may determine the format in which the data must be recorded. For example, some projects may require that all field information be recorded in the field logbook and may not allow the use of standardized forms. The requirements necessary to meet the data quality objectives for a particular project will be defined in the site-specific workplan and/or Quality Assurance Project Plan (QAPP) hereafter referred to as the project plan.

The field records will be reviewed by the Field Team Leader, or by the Project Manager or his/her designate, for accuracy, completeness, and adherence to the requirements of this POP. At a minimum, this must occur at the end of the field event. For field activities of extended duration, it is recommended that this review occur more frequently (e.g., daily or weekly).

If information recorded in the field is transcribed to another format, the original record must be retained for comparison purposes.

Periodic copying of the field records should be considered to insure against the loss or destruction of the original documents.

7.0 Data and records management

At the end of the field program, original field records must be placed in the project files and maintained for a certain retention time. The duration of record retention will be determined by project-specific requirements, or, in the absence of project requirements, by AECOM Corporate policy.

8.0 Personnel qualifications and training

The Project Manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan. In the absence of a Field Team Leader, the Project Manager is responsible for ensuring that field records are reviewed and approved as described below.

The Field Team Leader is responsible for reviewing and approving the field records for accuracy, completeness, and conformance to the procedures in this POP.

Field personnel are responsible for recording data according to the procedures outlined in this POP.

9.0 References

POP 002 Chain of Custody Procedures

POP 010 Packaging and Shipment of Environmental Samples

USACE. 2001. Requirements for the Preparation of Sampling and Analysis Plans. EM 200-1-3. United States Army Corps of Engineers. 1 February 2001.

USEPA. 2004. Contract Laboratory Program Guidance for Field Samplers. OSWER 9240.0-35. EPA540-R-00-003. United States Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. August 2004.

USEPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. United States Environmental Protection Agency, Region 4, Athens, GA.November 2001.

USEPA. 1998. Test Methods for Evaluating Solid Wastes. Physical/Chemical Methods (SW-846). Third edition, including all final updates.

USEPA. 1992. RCRA Ground-water Monitoring: Draft Technical Guidance. United States Environmental Protection Agency, Office of Solid Waste, Washington, DC. November 1992.

10.0 Revision History

Revision	Date	Changes
0	March 2010	Original POP

Table 1. Specific Information to Be Recorded

Site name and location
Personnel on site (AECOM, clients, site contacts, regulators, oversight personnel, subcontractors, general public)
Results of phone calls, conversations
Chronology of activities, including mobilization, investigatory activities, and demobilization
Weather conditions (initial and any changes; temperature, barometric pressure, wind conditions, precipitation)
Tidal stage (if applicable)
Inspections of equipment, materials, supplies (problems, corrective action)
Subcontractor name, description of services to be provided, and any issues (problems, stand by time)
Description of major equipment (drill rigs, backhoe, survey vessels, sampling platforms)
Field measurements • Description of procedure • Instruments (make, model, serial number, lamp) • Instrument calibration (date, time, personnel, standard, lot number, standard expiration date, true/measured results, units, corrective action, calibration checks and results) • Results (including units of measure, any correction factors applied, documentation of calculations (if applicable) • Date and time of measurement • Identity of person performing the measurements • Atmospheric conditions (if applicable)
Equipment decontamination procedures and materials
Well information (depth to water, static water depth, condition of well)
Well purging information (procedure, equipment, volumes, pumping rate, criteria for acceptance, time and date)

Presence and detection of immiscible layers, detection method, sampling method
Sampling information • Procedures and equipment (type and material) • Sample (soil) selection criteria/rationale (PID, staining, water table) • Sample location identification (e.g., boring, well identification) • Sample location description (sketch, GPS coordinates, compass and distance measurements from fixed points). • Sample depth • Sample flow rate/drawdown • Sample description (recovery, moisture, color, odor, texture, turbidity, artifacts) • Sample manipulations (filtration, homogenization, compositing, preservation) • Sample date and time • Unique sample ID • Identity of sampler • Sample parameters, containers (size/type), preservation • QC samples (field duplicates, trip blanks, field/equipment blanks, MS/MSDs, split samples) – include ID, associated field sample, method of collection
Any pertinent field observations that could affect data quality (instrument problems, contamination sources)
Deviations from approved plan (schedule modifications, relocation or elimination of sample locations, change orders), including rationale
Investigation-derived waste (IDW) types, volumes, storage, and disposal
Health and safety (H&S) meetings, personal protective equipment (PPE) worn, H&S monitoring

Project Operating Procedure

Chain-of-Custody Procedures

Procedure Number: 002

Revision No.: 0

Revision Date: March 2010

Robert Shoemaker, POP Author

Date: March 2010

Lucas Hellerich, Project Manager

Date: March 2010

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________

Initials: ________ Date: ________

Project Operating Procedure

Chain-of-Custody Procedures

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Project Operating Procedure

Chain-of-Custody Procedures

1.0 Project Scope and applicability

Chain-of-custody (COC) is defined as the unbroken trail of accountability that ensures the physical security of samples, data, and records (EPA Glossary of Quality-Related Terms). This project operating procedure (POP) describes COC procedures applicable to environmental samples collected by AECOM during field sampling and analysis programs. Custody procedures within the laboratories analyzing the samples are not addressed.

Samples are physical evidence. The objective of COC procedures is to provide sufficient evidence of sample integrity to satisfy data defensibility requirements in legal or regulatory situations.

The National Enforcement Investigations Center (NEIC) of the U.S. Environmental Protection Agency (EPA) defines custody of evidence in the following manner:

- It is in your actual possession;
- it is in your view, after being in your physical possession;
- it was in your possession and then you locked or sealed it up to prevent tampering; or
- it is in a secure area.

This POP is to be utilized to conduct the work identified in the title of this POP. In the event the Project Manager or Project Team determines that the protocols and procedures listed in this POP are not applicable to the project, the POP will be updated as a subsequent revision.

2.0 Health and safety considerations

The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager

3.0 Interferences

The following may impact the legal or regulatory defensibility of the data:

- The samples are not accompanied by a COC form,
- The information recorded on the COC form is incomplete, inaccurate, or differs from the information recorded on the sample containers,

4.0 Equipment and materials

The following materials are relevant to this procedure:

- COC Form (Figure 1)
- Sample labels
- COC tape or seal (Figure 2)
- Indelible pen or Sharpie™
- Clear plastic sealing tape

Materials identified in related POPs may also be needed

5.0 Procedures

5.1 Pre-sample collection activities

Some measurement methods require preparation of sample collection media or special treatment of sample containers prior to sample collection. In these cases, COC procedures should be initiated with the media preparation or container treatment. This requires that sample identification numbers or media/container identification numbers be assigned. These numbers should be entered on the COC form, leaving room for the subsequent recording of the associated sample numbers. In this variation, the custodian responsible for media preparation or container treatment has the responsibilities outlined in Section 5.2, and the sampler or field sample custodian has the responsibilities stated in Section 5.3 when he or she receives the prepared media or treated containers. There are a number of acceptable approaches to this variation, and the detailed procedures should be defined in the project-specific Quality Assurance Project Plan (QAPP).

5.2 Sample collection phase

As few people as possible should handle the samples. For certain programs, it is helpful if a single person is designated as the sample custodian (the person responsible for the care and custody of the samples until they are transferred to the laboratory for analysis).

While in the field, sampling personnel should be able to testify that tampering of the samples could not occur without their knowledge. Examples of actions taken may include sealing the sample containers with COC tape or locking the samples in a secure area.

If samples are to be shipped by commercial overnight carrier, the field sampler or sample custodian completes a COC form (Figure 1) for each cooler/package of samples and places the original of completed form inside the associated cooler/package before the package is sealed (a copy is retained and kept in the field record files). Each completed COC form should accurately list the sample identification numbers of the samples with which it is packaged, and should contain the identification number of the COC tape on the cooler/package. Representatives of commercial carriers are not required to sign the COC form. Refer to POP 010 Packaging and Shipment of Environmental Samples for specific packaging procedures.

If samples are hand carried to a laboratory, the person hand carrying the samples is the sample custodian. If the carrier is a different person than the one who filled out the COC form and packaged the samples, then that person transfers custody to the carrier by signing and dating each form in the "Relinquished By" section. The carrier then signs and dates each form in the adjacent "Received By" section. When the carrier transfers the samples to the laboratory, he or she signs and dates each form in the next "Relinquished By" section, and the laboratory sample custodian signs and dates each form in the adjacent "Received By" section.

If samples are transmitted to the laboratory by courier, the procedures described in either Section 5.2.3 or 5.2.4 are followed, depending on whether the courier is a commercial courier or laboratory representative, and whether the cooler has been secured by COC seals prior to pick up by a laboratory courier.

5.3 Sample labeling

Labeling of samples occurs at the time of sample collection.

Waterproof, adhesive labels are preferred. Labels should be applied to the container, not the lid whenever possible. Additional interior labels may be required for certain biological samples.

Sample tags may be required for certain projects requiring a strict level of legal or regulatory data defensibility. If tags are utilized, their use will be addressed in the project-specific work plan or QAPP.

Labels should be completed in waterproof, indelible ink. Covering the label with clear plastic tape is recommended to protect the legibility of the label and to prevent the label from detaching from the sample container.

The following information should be recorded on the sample label:

- Project identification (project name and number/client/site)
- Field sample identification code (exactly as it appears on the COC form)
- Sampler’s initials
- Date and time of sample collection
- Analyses requested
- Preservation

5.4 Documentation of sample history

Sample history includes, but is not limited to, preparation of sample containers or collection media (for example, wipes), collection, handling (such as subsampling or compositing), storage, shipment, analytical preparation and analysis, reporting, and disposal.

Refer to POP 001 Recording of Field Data, for specific guidance on documentation of field activities, field measurements, and sample collection.

5.5 Documentation of custody

It is recommended that a COC form (Figure 1 or equivalent) be initiated upon sample collection. If this is not feasible for a particular project, the COC form may be initiated at the time of sample packaging. If this is the case, the sample collection records will serve as the initial custody document and will document the collection of the sample (sample location and identification, date and time of collection, sampler, and parameters to be analyzed, including containers and preservatives).

The following information is recorded on the COC form:

- Project identification (AECOM project number, client, site name and location).
- Page number (for example, 1 of 2, 2 of 2).
- Field sample identification code. This code should be unique to the sampling event and to the program. This code should agree exactly with the field sample identification code recorded on the bottle label.
- Sampling point location (optional if recorded elsewhere in field records).
- Date and time of sample collection.
- Sample matrix (soil, water, air, etc.).
- Preservative.
- Analysis requested.
- Number of containers.
- Type of sample (grab or composite). Identifying if aqueous samples have been filtered in the field is recommended.
- Signature(s) of sampling personnel and signatures of all personnel handling, receiving, and relinquishing the samples.
- Date(s) and time(s) of each sample transfer.
- Sampler remarks. These comments may serve to alert the laboratory to highly contaminated samples or identify quality control (QC) sample requirements.
- Airbill number (if shipped by overnight commercial carrier).
- Laboratory name and address.

5.6 COC tape numbers.

The COC is filled out completely and legibly in indelible ink. There should be no unexplained blank spaces. Blank lines should be lined out and initialed and dated.

Data will not obliterated. Corrections are made, if necessary, by drawing a single line through and initialing and dating the error. The correct information is then recorded with indelible ink.

Information on the COC should agree exactly with that recorded on the sample containers. Discrepancies may result in the samples being incorrectly logged into the laboratory or delays in initiating sample analysis.

5.7 Sample receipt and inspection

Upon sample receipt, the coolers or packages are inspected for general condition and the condition of the COC tape. The coolers or boxes are then opened and each sample is inspected for damage.

Sample containers are removed from packing material and sample label information is verified against the COC form.

The condition upon receipt, including any discrepancies or problems, is documented and the COC form is completed by signing and recording the date and time of receipt.

Receipt and inspection of samples by subcontractor analytical laboratories will adhere to written procedures established by the laboratory.

6.0 Quality assurance / quality control

The records generated in this procedure are subject to review by the sampling team leader, project manager, or designee.

The records generated in this procedure will become a part of the evidence reviewed in the data validation process.

7.0 Data and records management

The records generated in this procedure are part of the permanent record supporting the associated measurements and may include, as applicable, the COC forms, sample tags, carrier waybills, and field and laboratory records of sample history (collection, handling, storage, analysis, etc.).

Unanticipated changes to the procedures or materials described in this POP (deviations) should be appropriately documented in the project records.

Records associated with the activities described in this POP should be maintained according to the document management policy for the project.

8.0 Personnel qualifications and training

8.1 Qualifications and training

The individual executing these procedures should have read, and be familiar with, the requirements of this POP.

No specialized skills are necessary in order to implement these procedures; however, an understanding of the concept of custody is useful.

8.2 Responsibilities

The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

For certain sampling programs, the project manager, sampling team leader, or designee may assign an individual to serve as sample custodian. This individual is responsible for supervising the implementation of COC procedures in accordance with this POP and any project-specific work plans or QAPP.

9.0 References

American Society for Testing and Materials (ASTM). 2004. Standard Guide for Sample Chain-of-Custody Procedures. D 4840-99 (Reapproved 2004).

POP 010 Packaging and Shipment of Environmental Samples

POP 001 Recording of Field Data

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

10.0 Revision history

Revision	Date	Changes
0	March 2010	Original POP

Figure 1. Chain-of-Custody Form

AECOM

CHAIN OF CUSTODY RECORD

Page ____ of ____

Client/Project Name:	Project Location:	
Project Number:	Field Logbook No.:	
Sampler (Print Name)/(Affiliation):	Chain of Custody Tape Nos.:	
Signature:	Send Results/Report to:	TAT:

Analysis Requested

Container Type
P – Plastic
A – Amber Glass
G – Clear Glass
V – VOA Vial
O – Other
E – Encore

Preservation
1 – HCl, 4°
2 – H2SO4, 4°
3 – HNO3, 4°
4 – NaOH, 4°
5 – NaOH/ZnAc, 4°
6 – Na2S2O3, 4°
7 – 4°

Matrix Codes:
DW – Drinking Water
WW – Wastewater
GW – Groundwater
SW – Surface Water
ST – Storm Water
W – Water
S – Soil
SL – Sludge
SD – Sediment
SO – Solid
A – Air
L – Liquid
P – Product

Field Sample No./Identification	Date	Time	COMP	GRAB	Sample Container (Size/Mat'l)	Matrix	Preserv.	Field Filtered											Lab I.D.	Remarks

Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	Analytical Laboratory (Destination):
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	Sample Shipped Via: UPS FedEx Courier Other Temp blank Yes No

Serial No. ____________

Figure 2. Chain-of-Custody Tape

№

Signature ______________________________

Date ______________________________

Project Operating Procedure

Operation and Calibration of a Photoionization Detector

Procedure Number: 004

Revision No.: 0

Revision Date: March 2010

Robert Shoemaker, POP Author

Date: March 2010

Lucas Hellerich, Project Manager

Date: March 2010

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________

Initials: ________ Date: ________

Project Operating Procedure

Operation and Calibration of a Photoionization Detector

Contents

Project Operating Procedure

Operation and Calibration of a Photoionization Detector

1.0 Project Scope and applicability

1.1 Purpose and Applicability

This document describes the procedures that will be followed by field staff for operation and calibration of a photoionization detector (PID). The PID is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.

PIDs routinely used by AECOM personnel include the Photovac Microtip, Thermoelectron 580EZ, and MiniRAE 2000. Personnel responsible for using the PID should first read and thoroughly familiarize themselves with the instrument instruction manual.

1.2 Principle of Operation

The PID is a non-specific vapor/gas detector. The unit generally consists of a hand-held probe that houses a PID, consisting of an ultraviolet (UV) lamp, two electrodes, and a small fan which pulls ambient air into the probe inlet tube. The probe is connected to a readout/control box that consists of electronic control circuits, a readout display, and the system battery. Units are available with UV lamps having an energy from 9.5 electron volts (eV) to 11.7 eV.

The PID analyzer measures the concentration of trace gas present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule (in electron volts (eV)) is less than the energy of the photon. The source of photons is an ultraviolet lamp in the probe unit. Lamps are available with energies ranging from 9.5 eV to 11.7 eV. All organic and inorganic vapor/gas compounds having ionization potentials lower than the energy output of the UV lamp are ionized and the resulting potentiometric change is seen as a positive reading on the unit. The reading is proportional to the concentration of organics and/or inorganics in the vapor.

Sample gases enter the probe through the inlet tube and enter the ion chamber where they are exposed to the photons emanating from the UV lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive- biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This current is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.

In service, the analyzer is first calibrated with a gas of known composition equal to, close to, or representative of that to be measured. Gases with ionization potentials near to or less than the energy of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials greater than the energy of the lamp will not be detected. The ionization potentials of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range from about

12.0 eV to 15.6 eV and are not ionized by any of the lamps available. Gases with ionization potentials near to or slightly higher than the lamp are partially ionized, with low sensitivity.

1.3 Specifications

Refer to the manufacturer's instructions for the technical specifications of the instrument being used. The operating concentration range is typically 0.1 to 2,000 ppm isobutylene equivalent.

2.0 Health and safety considerations

The health and safety considerations for the site, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

Only PIDs stamped Division I Class I may be used in explosive atmospheres. Refer to the project HASP for instructions pertaining to instrument use in explosive atmospheres.

3.0 Interferences

Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.

Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

4.0 Equipment and materials

- Calibration Gas: Compressed gas cylinder of isobutylene in air or similar stable gas mixture of known concentration. The selected gas should have an ionization potential similar to that of the vapors to be monitored, if known. The concentration should be at 50-75% of the range in which the instrument is to be calibrated.

- Regulator for calibration gas cylinder
- Approximately 6 inches of Teflon® tubing
- Tedlar bag (optional)
- Commercially-supplied zero grade air (optional)
- "Magic Marker" or "Sharpie" or other waterproof marker
- Battery charger
- Moisture traps
- Spare lamps
- Manufacturer's instructions
- Field data sheets or logbook/pen

5.0 Procedures

5.1 Preliminary Steps

Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

5.2 Calibration

The PID must be calibrated in order to display concentrations in units equivalent to ppm. First a supply of zero air (ambient air or from a supplied source), containing no ionizable gases or vapors is used to set the zero point. A span gas, containing a known concentration of a photoionizable gas or vapor, is then used to set the sensitivity.

Calibrate the instrument according to the manufacturer's instructions. Record the instrument model and identification number, the initial and adjusted meter readings, the calibration gas composition and concentration, and the date and the time in the field records.

If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 4.4).

5.3 Operation

Turn on the unit and allow it to warm up (minimum of 5 minutes). Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify on the readout display that the UV lamp is lit.

Calibrate the instrument as described in Section 4.2, following the manufacturer's instructions. Record the calibration information in the field records.

The instrument is now operational. Readings should be recorded in the field records.

When the PID is not being used or between monitoring intervals, the unit may be switched off to conserve battery power and UV lamp life; however, a "bump" test should be performed each time the unit is turned on and prior to taking additional measurements. To perform a bump test, connect the outlet tubing from a Tedlar bag containing a small amount of span gas to the inlet tubing on the unit and record the reading. If the reading is not within the tolerance specified in the project plan, the unit must be recalibrated.

At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 4.2) except that no adjustment will be made to the instrument. Record the information in the field records.

Recharge the battery after each use (Section 5.4).

When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

5.4 Routine Maintenance

Routine maintenance associated with the use of the PID includes charging the battery, cleaning the lamp window, replacing the detector UV lamp, replacing the inlet filter, and replacing the sample pump. Refer to the manufacturer's instructions for procedures and frequency.

All routine maintenance should be performed in a non-hazardous environment.

5.5 Troubleshooting Tips

One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant reading should readily be observed.

Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.

A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings. The PID should never be operated without the moisture trap in place.

Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.

A zero reading on the meter should not necessarily be interpreted as an absence of air contaminants. The detection capabilities of the PID are limited to those compounds that will be ionized by the particular probe used.

Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.

When high vapor concentrations enter the ionization chamber in the PID the unit can become saturated or “flooded”. Remove the unit to a fresh air environment to allow the vapors to be completely ionized and purged from the unit.

6.0 Quality assurance / quality control

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific work plan or Quality Assurance Project Plan (QAPP), hereafter referred to as the project plan.

Calibration of the PID will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The PID will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within ±10%. If the instrument responds outside this tolerance, it must be recalibrated.

Checks of the instrument response (Section 5.5) should be conducted periodically and documented in the field records.

7.0 Data and records management

Safety and survey monitoring with the PID will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number.
- Instrument manufacturer, model, and identification number.
- Operator's signature.
- Date and time of operation.
- Calibration gas used.
- Calibration check at beginning and end of day (meter readings before adjustment).
- Span setting after calibration adjustment.
- Meter readings (monitoring data obtained).
- Instances of erratic or questionable meter readings and corrective actions taken.

- Instrument checks and response verifications – e.g., battery check, magic marker response (Section 4.5.1) or similar test.

8.0 Personnel qualifications and training

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan.

The field operator is responsible for verifying that the PID is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this POP and the project plan.

9.0 References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

10.0 Revision History

Revision	Date	Changes
0	March 2010	Original POP

Project Operating Procedure

Surface and Subsurface Soil Sampling Procedures

Procedure Number: 006

Revision No.: 0

Revision Date: March 2010

Robert Shoemaker, POP Author — Date: March 2010

Lucas Hellerich, Project Manager — Date: March 2010

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

Project Operating Procedure

Surface and Subsurface Soil Sampling Procedures

Contents

List of Attachments

Project Operating Procedure

Surface and Subsurface Soil Sampling Procedures

1.0 Project Scope and applicability

This project operating procedure (POP) is applicable to soil sampling. The procedure includes surface and subsurface sampling by various methods using hand auguring, test pit, direct-push, and split-spoon equipment. The procedure includes soil sampling for volatile organic compounds (VOCs). For project specific information (e.g. sampling depths, equipment to be used, and frequency of sampling), refer to the Work Plan, which takes precedence over these procedures.

Surface soil sampling, typically considered to be up to two feet below ground surface by EPA standards, is typically accomplished using hand tools such as shovels or hand augers. Test pit samples are considered subsurface samples, although normally collected via hand tools similar to surface soil sampling or by excavation machinery. Direct-push and split-spoon sampling offer the benefit of collecting soil samples from a discrete or isolated subsurface interval, without the need of extracting excess material above the target depth. These methods dramatically reduce time and cost associated with disposal of material from soil cuttings when compared to test pit sampling. In addition, direct-push and split-spoon sampling methods can obtain samples at targeted intervals greater than 15 feet in depth, allowing for discrete depth soil sampling while speeding up the sampling process. Direct-push methods work best in medium to fine-grained cohesive materials such as medium to fine sands, silts, and silty clay soils. Split-spoon sampling works well in all types of soil, but is somewhat slower than direct-push methods. Samples are composited so that each sample jar to be analyzed contains a homogenized representative portion of the interval samples. Due to potential loss of analytes, samples for volatile analysis are not composited. Samples for chemical analysis can be collected by any of the above-mentioned sampling methods, as disturbed soil samples. Undisturbed samples are collected, sealed, and sent directly to the laboratory for analysis. For undisturbed samples, the samples are not homogenized.

2.0 Health and safety considerations

All calibration, maintenance and servicing of soil sampling equipment and instrumentation should be performed in a safe area, away from hazardous locations.

Refer to the Site-Specific Health and Safety Plan for health and safety issues and equipment/instrumentation needed. General health and safety equipment includes a combustible gas indicator (CGI), photo/flame ionization detector (PID/FID), tyvek, gloves, safety glasses, and steel-toe boots.

The Site-Specific Health and Safety Plan should be followed during all site activities. Health and safety meetings should be held each day prior to the commencement of activities.

Before soil sampling commences, appropriate entities (e.g. DigSafe, local public works departments, company facilities) must be contacted to assure the anticipated soil sampling locations are marked for utilities, including electrical, telecommunications, water, sewer, and gas.

3.0 Interferences

Low recovery of soil from sampling equipment will prevent an adequate representation of the soil profile and sufficient amount of soil sample. If low recovery is a problem, the hole may be offset and re-advanced, terminated, or continued using a larger diameter sampler.

Asphalt in soil samples can cause false positive results for hydrocarbons. To ensure samples are free of asphalt, do not collect sample from soil with possible asphalt. Note the sampling depth(s) and the depths at with the presence of asphalt are suspected.

Instrumentation interferences addressed in POPs for Calibration of the PID, Headspace Screening for Total Volatile Organics, and Equipment Decontamination Procedures must also be considered.

Cross contamination from sampling equipment will be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

4.0 Equipment and materials

The depth at which samples will be collected and the anticipated method of sample collection (direct-push, split-spoon, hand auger, shovel, or test pits) will be presented in the Work Plan. The following details equipment typically needed for soil sampling, based on the various methods. See the Work Plan for specific detail of equipment and supply needs.

Depending on the nature of suspected contamination, field screening instrumentation may be used to direct sampling. Appropriate instrumentation and calibration standards should be available. If volatile organic contaminants are suspected and a PID will be used, refer to the equipment and instrumentation listed in the POP 004 Operation and Calibration of a Photoionization Detector. Equipment in this POP includes but is not limited to:

- PID/FID
- Calibration gas
- Tedlar® gas bags (for calibration)

If field screening methods include jar headspace screening for volatile organics, refer to the equipment and procedure in the POP No. 007 Headspace Screening for Total VOCs. Equipment in this POP includes but is not limited to:

- Clean soil (“drillers jars”) jars
- Aluminum foil

Appropriate decontamination procedures must be followed for sampling equipment. Refer to POP No. 009 Decontamination of Field Equipment. Equipment in this POP includes but is not limited to:

- Phosphate-free detergent
- Isopropyl Alcohol
- Tap water
- Deionized Ultra-Filtered (DIUF) Water
- Plastic buckets or washbasins
- Brushes
- Polyethylene sheeting

The following general equipment is needed for all soil sampling, regardless of method:

- Stainless steel bowls
- Stainless steel trowels
- Appropriate sample containers for laboratory analysis
- CGI (as necessary – i.e. sites where explosive gasses may be encountered)
- Personal Protective Equipment (PPE)
- Log Book
- Cooler and ice for preservation
- Stakes and flagging to document sampling location

The following additional equipment is needed for volatile organic sampling:

- Electronic pan scale and weights for calibration
- Syringes or other discrete soil core samplers

The following additional equipment may be needed for surface and test pit soil sampling:

- Hand Auger

The following additional equipment may be needed for soil sampling from split-spoon equipment:

- Tape measure or folding carpenter’s rule for recording the length of soil recovered in the split-spoon.

All subsurface drilling equipment will be provided and maintained by the subcontractor.

5.0 Procedures

5.1 General Soil Sampling Procedure for All Soil Sampling Methods

1. Record the weather conditions and other relevant on-site conditions.
2. Select the soil sampling location, clear vegetation if necessary, and record the sampling location identification number and pertinent location details.
3. Verify that the sampling equipment is properly decontaminated, in working order, and situated at the intended sampling location.
4. Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it. Cover surfaces onto which soils or soil samplers will be placed (i.e. tables with polyethylene sheeting).
5. Follow the appropriate procedures listed below for either surface, split-spoon, direct push, or test pit sample collection (5.2, 5.3, 5.4, and 5.5 respectively).
6. Collect soil samples according to procedures listed in Section 5.6 depending on project specific analyses.
7. Record date/time, sample ID, and sample descriptions in the field logbook for field form. A sketch or description of the location should also be recorded so the sample location can be re-constructed.
8. Immediately label (and tag if required) the sample containers and place them on ice, if required for preservation. Complete the CoC form(s) as soon as possible.
9. Dispose of all excess excavated soil in accordance with the site-specific Work Plan. Soils may either be segregated based on level of contamination, stockpiled, drummed for disposal, or put back into the hole from which the soil came.
10. Upon completion, clearly label a wooden stake or pin flag with indelible ink and stake or flag the sampling location.
11. Decontaminate the sampling equipment according to POP No. 009 Decontamination of Field Equipment.

5.2 Surface Sampling

The following procedures are to be used to collect surface soil samples. Surface soils are considered to be soils that are up to one (1) foot below ground surface, though state regulations and project objectives may define surface soils differently; therefore, the Work Plan should be consulted for direction on the depth from which to collect the surface soil samples. Sampling and other pertinent data and information will be recorded in the field logbook and/or on field forms. Photographs will be taken as needed or as specified in the Quality Assurance Project Plan (QAPP).

1. Gently scrape any vegetative covering until soil is exposed. Completely remove any pavement.
2. Remove soil from excavation with a trowel, hand auger, or shovel. Put soils within the sampling interval in a stainless steel bowl for homogenizing. Monitor the excavation as required in the site-specific HASP and/or QAPP (i.e., PID).

The criteria used for selecting surface soil locations for sampling may include the following:

- Visual observations (soil staining, fill materials)
- Other relevant soil characteristics
- Site features
- Screening results
- Predetermined sampling approach (i.e. grid or random)
- Sampling objectives as provided in the Work Plan and/or QAPP

3. For VOC analyses, collect representative soil samples directly from the recently-exposed sidewall of the excavation using a syringe or other soil coring device (e.g,, TerraCore®, EnCore®). Follow procedures in Section 5.6.1 for VOC sampling.
4. Collect sufficient soil to fill all remaining sample jars into a stainless steel bowl. Homogenize the soil samples to obtain a uniform soil composition which is representative of the total soil sample collected according to the following procedure:
   a) Remove all rocks and non-soil objects using a stainless steel spoon or scoop.
   b) Form a cone shaped mound with the sample material, then flatten the cone and split the sample into quarters.
   c) Use the stainless steel spoon/scoop to mix the quarter samples that are opposite.
   d) After mixing the opposite quarters, reform the cone shaped mound.
   e) Repeat this procedure a minimum of five (5) times, removing any non-soil objects and breaking apart any clumps.

5.3 Split-Spoon Sampling

1. At each boring location, the frequency and depth of split-spoon samples will be determined from the Work Plan. Split-spoon samples may be collected continuously, intermittently, or from predetermined depths.
2. Standard penetration tests will be conducted according to ASTM D1586-99, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils to record the number of hammer blows required to advance the sampler each 6 inches of depth in the boring log.

3. Split-spoon samplers shall be driven into undisturbed soil by driving the spoon ahead of the drill augers/casing. In cohesive soils, or soils where the borehole remains open (does not collapse), two split-spoon samples may be taken prior to advancing the augers/casing.
4. After split-spoons are retrieved, open the split-spoon and measure the recovery of soil. If a PID will be used for screening, immediately scan the recovered sample for VOCs using a PID/FID. Scan the recovered soil by making a hole in the soil and placing the PID in or very close to the hole. Be very careful not to get soil on the tip of the PID. Take these PID scan readings every 6 inches along the split-spoon. Note any staining and/or presence of water. Record the highest PID reading and the depth at which it was observed along with other observations. If required in the Work Plan, VOC and headspace samples should be collected (see Section 5.6.1) prior to logging the sample.
5. If headspace screening for VOCs is required in the Work Plan, collect a soil sample (as defined in the Work Plan) and perform headspace screening according to POP No. 007 Headspace Screening for Total VOCs.
6. Soils collected using the split-spoon sampler will be logged by the AECOM field representative using the procedure described in ASTM D2488-00 Standard Practice for Description and Identification of Soils. In addition to the description of the soils, blow counts, sample recovery, PID readings (headspace), and the depth to water will also be recorded.
7. Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 5.2.
8. The Work Plan may specify that intervals to be sent to the laboratory be determined by visual observation and/or highest PID screening or headspace results, which can only be determined once the boring is complete. In this instance, a VOC sample should be collected at each interval. The remainder of the soil from that interval will be set aside in a clearly labeled stainless steel bowl covered with aluminum foil. Once the boring has been completed and the sample interval has been determined, the remainder of the soil can be homogenized according to Section 5.2 and submitted for laboratory analysis.
9. Once a boring is complete and all required samples have been collected, the boring may be filled or a monitoring well or piezometer may be installed. Borings must be completed as specified in the Work Plan.

5.4 Direct Push Sampling

At each boring location, the frequency of direct-push samples will be determined from the Work Plan. Typically, samples with direct-push equipment are collected in 4 ft intervals.

1. Sample using either 2' or 4' Macro-Core samplers with acetate liners to obtain discrete soil samples at specific depths.

2. Cut open the acetate liner, and immediately scan the recovered sampler for VOCs using a PID/FID. Note any staining and/or presence of water. Record the highest PID reading and the depth at which it was observed along with other observations. VOC and headspace samples, if required in the Work Plan should be collected (see Section 5.6.1) prior to logging the sample.
3. If required in the Work Plan, collect a soil sample (as defined in the Work Plan) and perform headspace screening according to POP No. 007 Headspace Screening for Total VOCs.
4. Soils collected using the direct-push sampler will be logged by the AECOM field representative using the procedure described in ASTM D2488-00 Standard Practice for Description and Identification of Soils. In addition to the description of the soils and sample recovery, PID readings (headspace), and the depth to water will also be recorded.
5. Collect the remainder of the sample into a stainless steel bowl. Homogenize the soil collected so that the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 5.2.
6. Once a boring is complete and all required samples have been collected, the boring may be filled or a monitoring well or piezometer may be installed. Borings must be completed as specified in the Work Plan.

5.5 Test Pit Sampling

1. Excavate the test pit to the desired depth.
2. Using the excavator bucket, collect soil samples as specified in the Work Plan. Collect a sample and perform screening analyses as required by the Work Plan. If VOCs contamination is suspected, perform headspace screening according to POP No. 007 Headspace Screening for Total VOCs.
3. Collect the sample from center of the bucket to avoid potential contamination from the bucket.
4. VOC samples should also be collected from an undisturbed section soil in the excavator bucket. The top layer of exposed soil should be scraped away just prior to collecting the VOC samples.
5. Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in section 5.2.
6. Dispose of all excavated soil according to the Work Plan.

5.6 Sample Collection Methods

5.6.1 Volatile Organics Sampling

For soils collected for analyses of volatile organics, including Volatile Petroleum Hydrocarbons (VPH) or other purgable compounds, a closed system is maintained. From collection through analysis, the sample bottles are not opened. The bottle kit for a routine field sample for these analyses will typically include three 40-mL VOA vials and one soil jar. Two 40-mL VOA vials will contain either 5 mL reagent water or 5 mL sodium bisulfate and magnetic stir bars (i.e., low level vials). The third VOA vial will contain 15 mL methanol with no magnetic stir bar (i.e., high level vial). These vials are usually provided by the laboratory and are pre-weighed. No sample labels are affixed to the VOA vials, as addition of a label would alter the vial weight. All information is recorded directly on the VOA vial using indelible marker. The soil jar is provided for percent solids determination. For VOC or VPH analyses, samples are collected prior to sample homogenization. Collect the VOC sample in accordance with the procedure described below.

1. Prior to sampling, weigh the 40-mL VOA vials received from the laboratory or purchased by AECOM. Record this weight. This weight will be used to determine if the proper amount of soil has been added to the vial.
2. Determine the soil volume necessary for the required sample weight, typically 5 grams:
    a) Prepare a 5 mL sampling corer (e.g., Terra Core®) or cut-off plastic syringe.
    b) Tare the sampler by placing it on the scale, and zeroing the scale.
    c) Draw back the plunger to the 5 gram mark or 5mL (5cc) mark on cut-off syringe, and insert the open end of the sampler into an undisturbed area of soil with a twisting motion, filling the sampler with soil. Note the location of the plunger with respect to the milliliter (cc) or other graduation printed on the sampler.
    d) Weigh the filled sampler, and remove or add soil until the desired weight is obtained. Note the location of the plunger which corresponds to this weight. Do not use this sample for laboratory analysis.
3. Once the required soil volume has been determined, pull the plunger back to this mark and hold it there while filling the syringe for each sample.
4. Collect 5 grams of soil using the cut-off syringe or Terra Core® sample device. Extrude the 5-grams of soil into one of the low level 40-mL VOA vials. Quickly wipe any soil from the threads of the VOA vial with a clean Kimwipe® and immediately close the vial. It is imperative that the threads be free from soil or other debris prior to replacing the cap on the vial in order to maintain the closed system necessary for the analysis.
5. Gently swirl the vial so that all of the soil is fully wedded with the preservative.
6. Weigh the 40 mL vial with the sample contained. Sample weight should be within 0.5 grams (±10%) of the target weight. Record the sample weight.

7. Fill the other low level 40 mL VOA vial in this manner,
8. Repeat the process for the high level VOA vials, only for the high level VOA vial three 5 gram aliquots (i.e., 15 grams total) should be extruded into the high level VOA vial.

NOTE: Depending on the laboratory, some high level VOA vials only contain 5 mL or 10 mL of methanol. If this is the case, either 5 grams total or 10 grams total, respectively, should be extruded into the high level VOA vial. In other words, the mass of soil in grams should be identical to the volume of methanol in mL (i.e., 1:1 ratio of soil to methanol).

9. Collect any additional QC sample collected (e.g., field duplicate, MS, and MSD) in the same manner as above.
10. Fill the 4-oz glass jar with soil from the same area for percent moisture determination.

5.6.2 Soil Sampling Method (All other analyses except VOC/VPH)

When all the required soil for a sampling location has been obtained, the soil can be homogenized as described in section 5.2. Collect sufficient volume to fill all of the remaining sample containers at least ¾ full for all other analyses. Homogenize the soil in a decontaminated stainless steel bowl, removing rocks, sticks, or other non-soil objects and breaking apart any lumps of soil prior to filling the remaining sample containers.

NOTE: Soil samples must contain greater than 30% solids for the data to be considered valid.

6.0 Quality assurance / quality control

Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

Quality control requirements are dependent on project-specific sampling objectives. The QAPP will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

7.0 Data and records management

All data and information (e.g., sample collection method used) must be documented on field data sheets, boring logs, or within site log books with permanent ink. Data recorded will include the following:

- weather conditions
- arrival and departure time of persons on site
- instrument type, lamp (PID), make, model and serial number
- calibration gas used
- date, time and results of instrument calibration and calibration checks
- sampling date and time
- sampling location
- samples collected
- sampling depth and soil type
- deviations from the procedure as written
- readings obtained

8.0 Personnel qualifications and training

All field staff are required to be OSHA 40-Hour Health and Safety certified with a current annual 8-hour refresher prior to engaging in any field collection activities.

Prior to implementation of these soil sampling procedures, the field sampler will be instructed by a person experienced with these procedures. The field staff will demonstrate to the field team leader the proper set-up, calibration, operation, and routine maintenance of the instrumentation and hand-held equipment, as well as the proper procedures, used to collect soil samples.

9.0 References

POP 004 Operation and Calibration of a Photoionization Detector

POP 007 Headspace Screening for Total VOCs

POP 009 Decontamination of Field Equipment

ASTM D1586-99, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils

ASTM D2488-00 Standard Practice for Description and Identification of Soils

10.0 Revision History

Revision	Date	Changes
0	March 2010	Original POP

Attachment 1. Example Boring Log

AECOM	*Client:*		*Boring ID:*
	Project Number:		
	Site Location:		
	Coordinates:	*Elevation:*	*Sheet: 1 of 1*
	Drilling Method:		*Monitoring Well Installed:*
	Sample Type(s):	*Boring Diameter:*	*Screened Interval:*
Weather:	*Logged By:*	*Date/Time Started:*	*Depth of Boring:*
Drilling Contractor:	*Ground Elevation:*	*Date/Time Finished:*	*Water Level:*

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (Ft.)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

NOTES:

Checked by ____________________ Date: ____________________

Date	Time	Depth to groundwater while drilling

Project Operating Procedure

Headspace Screening for Total VOCs

Procedure Number: 007

Revision No.: 0

Revision Date: March 2010

Robert Shoemaker, POP Author — Date: March 2010

Lucas Hellerich, Project Manager — Date: March 2010

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________

Initials: ________ Date: ________

Project Operating Procedure

Headspace Screening for Total VOCs

Contents

Project Operating Procedure

Headspace Screening for Total VOCs

1.0 Project Scope and applicability

POP 007 describes the basic techniques for using headspace analysis to screen for volatile organics in contaminated soils using a portable Photo Ionization Detector (PID) or Flame Ionization Detector (FID).

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, Job Hazard Analysis (JHA), Safety Task Analysis Review (STAR), or Site-Specific Health and Safety Plan (HASP) will take precedence over the procedures described in this document.

2.0 Health and safety considerations

This section presents the generic hazards associated with headspace screening and is intended to provide general guidance in preparing site-specific health and safety documents. The Site-Specific HASP, JHAs, and STARs will address additional requirements and will take precedence over this document. Note that headspace screening usually requires Level D personal protection unless there is a potential for airborne exposure to site contaminants. Under circumstances where potential airborne exposure is possible respiratory protective equipment may be required based on personal air monitoring results. Upgrades to Level C will be coordinated with your Site Safety and Health Officer (SSHO) or Environment, Health, and Safety (EHS) Coordinator.

Health and safety hazards and corresponding precautions include, but are not limited to, the following:

Dermal contact with contaminated soil. Personnel should treat all soil as potentially contaminated and wear chemically impervious gloves. Minimize skin contact with soil by using sampling instruments such as stainless steel spades or spoons. Do not touch any exposed skin with contaminated gloves.

Inhalation hazards. Appropriate air monitoring should be conducted to ensure that organic vapor concentrations in the breathing zone do not exceed action levels as specified in the Site-Specific HASP. When ambient temperatures are low enough to require warming samples using the vehicle heater, the vehicle's windows should be opened enough to prevent the build-up of any organic vapors. Use the PID or FID to verify the airborne concentrations in the vehicle remain below applicable action levels. Note that many volatile organic compounds (VOCs) are flammable and all precautions must be observed to eliminate any potential ignition sources.

Shipping limitations. Follow applicable regulations when shipping FID/PID equipment. When shipping an FID by air, the hydrogen tank must be bled dry. Calibration gas canisters are considered dangerous goods and must be shipped according to IATA and DOT regulations. Consult your EHS Coordinator and check with your shipping company to determine the correct shipping procedures.

3.0 Interferences

Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.

Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

4.0 Equipment and materials

The following materials must be on hand in good operating condition and/or in sufficient quantity to ensure that proper field analysis procedures may be followed.

- Calibrated PID/FID instrument
- Top-sealing "Zip-Loc" type plastic bags – or – 16 ounces of soil or "mason-" type glass jars and aluminum foil
- Project field book and/or boring logs
- PPE as specified in the Site-Specific HASP
- Material Safety Data Sheets (MSDSs) for any chemicals or site-specific contaminants
- A copy of the Site-Specific HASP

5.0 Procedures

5.1 Preparation

Review available project information to determine the types of organic vapors that will likely be encountered to select the right instrument. The two basic types of instruments are FIDs and PIDs.

FIDs work well with organic compounds that have relatively lightweight molecules, but may have problems detecting halogenated compounds or heavier organic compounds; FIDs can detect methane for example. Since the FID uses a flame to measure organic compounds, ensure that work is conducted in an atmosphere, which is free of combustible vapors. If ambient temperatures are below 40°F, the flame of the FID may be difficult to light.

When using a PID, select an instrument that can measure the ionization potential of the anticipated contaminants of concern. PIDs work well with a range of organic compounds and can detect some halogenated hydrocarbons; PIDs cannot detect methane. The correct ultraviolet (UV) light bulb must be selected according to the types of organic vapors that will likely be encountered. The energy of the UV light must equal or exceed the ionization potential of the organic molecules that the PID will measure. The NIOSH Pocket Guide to Chemical Hazards is one source for determining ionization potentials for different chemicals. Bulbs available for PIDs include 9.4 eV, 10.6 (or 10.2) eV, and 11.7 eV bulbs. The 10.6 eV bulb is most commonly used as it detects a fairly large range of organic molecules and does not burn out as easily as the 11.7 eV bulb. The 9.4 eV bulb is the most rugged, but detects only a limited range of compounds. Under very humid or very cold ambient conditions, the window covering the UV light may fog up, causing inaccurate readings. Ask your EHS coordinator about correction factors when high humidity conditions exist.

After selecting the correct instrument, calibrate the PID/FID according to POP 004 Operation and Calibration of a Photoionization Detector. Record background/ambient levels of organic vapors measured on the PID/FID after calibration and make sure to subtract the background concentration (if any) from your readings. Check the PID/FID readings against the calibration standard every 20 readings or at any time when readings are suspected to be inaccurate, and recalibrate, if necessary. Be aware that, after measuring highly contaminated soil samples, the PID/FID may give artificially high readings for a time.

5.2 Top-Sealing Plastic Bag

Place a quantity of soil in a top-sealing plastic bag and seal the bag immediately. The volume of soil to be used should be determined by the project manager or field task manager. The volume of soil may vary between projects but should be consistent for all samples collected for one project. Ideally, the bag should be at least 1/10th-filled with soil and no more than half-filled with soil. Once the bag is sealed, shake the bag to distribute the soil evenly. If the soil is hard or clumpy, use your fingers to gently work the soil (through the bag) to break up the clumps. Do not use a sampling instrument or a rock hammer since this may create small holes in the plastic bag and allow organic vapors to escape. Alternatively, the sample may be broken up before it is placed in the bag. Use a permanent marker to record the following information on the outside of the bag:

- Site identification information (i.e., borehole number)
- Depth interval
- Time the sample was collected. For example: “SS-12, 2-4 ft, @1425”

Headspace should be allowed to develop before organic vapors are measured with a PID/FID. The amount of time required for sufficient headspace development will be determined by the project-specific sampling plan and the ambient temperature. Equilibration time should be the same for all samples to allow an accurate comparison of organic vapor levels between samples. However, adjustments to equilibration times may be necessary when there are large variations in ambient temperature from day to day. When ambient temperatures are below 32°F, headspace development should be within a heated building or vehicle. When heating samples, be sure there is adequate ventilation to prevent the build-up or organic vapors above action levels.

Following headspace development, open a small opening in the seal of the plastic bag. Insert the probe of a PID/FID and seal the bag back up around the probe as tightly as possible. Alternatively, the probe can be inserted through the bag to avoid loss of volatiles. Since PIDs and FIDs are sensitive to moisture, avoid touching the probe to the soil or any condensation that has accumulated inside of the bag. Since the PID/FID consumes organic vapors, gently agitate the soil sample during the reading to release fresh organic vapors from the sample. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case, headspace data should be discounted. Record the highest reading on the field form or in the field notebook as described in Section 7.

5.3 Jar and Aluminum Foil (Alternate Method)

Half-fill a clean glass jar with the soil sample to be screened. Quickly cover the jar’s opening with one to two sheets of clean aluminum foil and apply the screw cap to tightly seal the jar. Allow headspace development for at least ten minutes. Vigorously shake the jar for 15 seconds, both at the beginning and at the end of the headspace development period. Where ambient temperatures are below 32°F (0°C), headspace development should be within a heated area. When heating samples, be sure there is adequate ventilation to prevent the build-up of organic vapors above action levels.

Subsequent to headspace development, remove the jar lid and expose the foil seal. Quickly puncture the foil seal with the instrument sampling probe, to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particulates. As an alternative, use a syringe to withdraw a headspace sample, and then inject the sample into the instrument probe or septum-fitted inlet. This method is acceptable contingent upon verification of methodology accuracy using a test gas standard. Following probe insertion through the foil seal or sample injection to probe, record the highest meter response on the field form or in the field notebook. Using foil seal/probe insertion method, maximum response should occur between two and five seconds. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case, headspace data should be discounted.

6.0 Quality assurance / quality control

Quality Assurance/Quality Control (QA/QC) will include the collection of duplicate samples. In general, one duplicate will be collected per 20 samples. Organic vapor concentrations measured in the primary and duplicate samples should be similar within plus or minus 20 percent. The frequency of headspace duplicate collection will be determined by the project manager/task manager. The PID/FID instrument must be calibrated according to the manufacturer’s instructions before beginning screening, and checked or recalibrated every 20 analyses or when readings are suspected to be inaccurate. Record ambient organic vapor levels in the field notebook and on the field form. Periodically check ambient organic vapor levels. If ambient levels have changed more than 20 percent, recalibrate the PID/FID. Make sure readings are not collected near a vehicle exhaust or downwind of the drill rig exhaust. If grossly contaminated soil is encountered, decontaminate sampling instruments between samples and/or change contaminated gloves to avoid cross contaminating less contaminated samples.

7.0 Data and records management

All data generated (results and duplicate comparisons) will be recorded in the field notebook and/or on the field form. Any deviation from the outlined procedure will also be noted. Field conditions (ambient temperature, wind, etc.) should also be recorded in the field notebook.

Readings may be recorded in a field notebook, on a boring log, or on an appropriate form specific to the project. The form should include the following information:

- When the PID/FID was calibrated (date/time) and calibration standard used
- Background/ambient concentrations measured after PID/FID calibration
- Location of sample (i.e., bore-hole number)
- Depth interval of sample measured
- Lithology of material measured
- PID/FID reading and units of measure

Note that if PID/FID measurements are recorded on a boring log, it is not necessary to duplicate information in the column where the PID/FID readings are recorded (e.g., borehole number, depth interval, lithology type).

All documentation will be stored in the project files and retained following completion of the project.

8.0 Personnel qualifications and training

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan.

The field operator is responsible for verifying that the PID is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this POP and the project plan.

9.0 References

POP 004 Operation and Calibration of a Photoionization Detector

10.0 Revision History

Revision	Date	Changes
0	March 2010	Original POP

Project Operating Procedure

Decontamination of Field Equipment

Procedure Number: 009

Revision No.: 0

Revision Date: March 2010

Robert Shoemaker, POP Author

Date: March 2010

Lucas Hellerich

Lucas Hellerich, Project Manager

Date: March 2010

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________

Initials: ________ Date: ________

Contents

Project Operating Procedure
Decontamination of Field Equipment

1.0 Project Scope and applicability

1.1 Purpose and Applicability

This POP describes the methods to be used for the decontamination of field equipment used in the collection of environmental samples. The list of field equipment may include a variety of items used in the collection of soil and/or water samples, such as split-spoon samplers, trowels, scoops, spoons, bailers and pumps. Heavy equipment such as drill rigs and backhoes also require decontamination, usually in a specially constructed temporary decontamination area.

Decontamination is performed as a quality assurance measure and a safety precaution. Improperly decontaminated sampling equipment can lead to misinterpretation of environmental data due to interference caused by cross-contamination. Decontamination protects field personnel from potential exposure to hazardous materials. Decontamination also protects the community by preventing transportation of contaminants from a site.

This POP emphasizes decontamination procedures to be used for decontamination of reusable field equipment. Occasionally, dedicated field equipment such as well construction materials (well screen and riser pipe) or disposable field equipment (bailers or other general sampling implements) may also require decontamination prior to use. The project-specific work plan should indicate the specific decontamination requirements for a particular project.

Respective state or federal agency (regional offices) regulations may require specific types of equipment or procedures for use in decontamination of field equipment. The project manager should review the applicable regulatory requirements, if any, prior to the start of the field investigation program.

1.2 General Principles

Decontamination is accomplished by manually scrubbing, washing, or spraying equipment with detergent solutions, tap water, distilled/deionized water, steam and/or high pressure water, or solvents. The decontamination method and agents are generally determined on a project-specific basis and must be stated in the Quality Assurance Project Plan (QAPP).

Generally, decontamination of equipment is accomplished at each sampling site between collection points. Waste decontamination materials such as spent liquids and solids will be collected and managed as investigation-derived waste for later disposal. All decontamination materials, including wastes, should be stored in a central location so as to maintain control over the quantity of materials used or produced throughout the investigation program.

2.0 Health and safety considerations

Decontamination procedures may involve chemical exposure hazards associated with the type of contaminants encountered or solvents employed and may involve physical hazards associated with decontamination equipment. When decontamination is performed on equipment which has been in contact with hazardous materials or when the quality assurance objectives of the project require decontamination with chemical solvents, the measures necessary to protect personnel must be addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing equipment decontamination, and must be adhered to as field activities are performed.

3.0 Interferences

Improper decontamination can result is sample contamination and affect the accuracy of data.

4.0 Equipment and materials

- Decontamination agents (per work plan requirements):
    - LIQUI-NOX, ALCONOX, or other phosphate-free biodegradable detergent,
    - Tap water,
    - Distilled/deionized water,
    - Nitric acid and/or hydrochloric acid,
    - Methanol and/or hexane, acetone, isopropanol.
- Health and Safety equipment
- Chemical-free paper towels
- Waste storage containers: drums, 5-gallon pails w/covers, plastic bags
- Cleaning containers: plastic buckets or tubs, galvanized steel pans, pump cleaning cylinder
- Cleaning brushes
- Pressure sprayers
- Squeeze bottles
- Plastic sheeting

- Aluminum foil
- Field project notebook/pen

5.0 Procedures

5.1 General Preparation

It should be assumed that all sampling equipment, even new items, are contaminated until the proper decontamination procedures have been performed on them or unless a certificate of analysis is available which demonstrates the items cleanliness.

Field equipment that is not frequently used should be wrapped in aluminum foil, shiny side out, and stored in a designated "clean" area. Small field equipment can also be stored in plastic bags to eliminate the potential for contamination. Field equipment should be inspected and decontaminated prior to use if the equipment appears contaminated and/or has been stored for long periods of time. Unless customized procedures are stated in the Work Plan and/or QAPP for decontamination of equipment, the standard procedures specified in this POP shall be followed.

Establish the decontamination station within an area that is convenient to the sampling location. If single samples will be collected from multiple locations, then a centralized decontamination station, or a portable decontamination station should be established.

An investigation-derived waste (IDW) containment station should be established at this time also. The project-specific work plan should specify the requirements for IDW containment. In general, decontamination solutions are discarded as IDW between sampling locations. Solid waste is disposed of as it is generated.

5.2 Decontamination for Organic Analyses

This procedure applies to soil sampling and groundwater sampling equipment used in the collection of environmental samples submitted for organic constituents analysis. Examples of relevant items of equipment include split-spoons, trowels, scoops/spoons, bailers, and other small items. Submersible pump decontamination procedures are outlined in Section 4.4.

Decontamination is to be performed before sampling events and between sampling points.

After a sample has been collected, remove all gross contamination from the equipment or material by brushing and then rinsing with available tap water. This initial step may be completed using a 5-gallon pail filled with tap water. Steam or a high-pressure water rinse may also be conducted to remove solids and/or other contamination.

Wash the equipment with a phosphate-free detergent and tap water solution. This solution should be kept in a 5-gallon pail with its own brush.

Rinse with tap water or distilled/deionized water until all detergent and other residue is washed away. This step can be performed over an empty bucket using a squeeze bottle or pressure sprayer.

Rinse with methanol or other appropriate solvent using a squeeze bottle or pressure sprayer. Rinsate should be collected in a waste bucket.

Rerinse with deionized water to remove any residual solvent. Rinsate should be collected in the solvent waste bucket.

Allow the equipment to air-dry in a clean area or blot with chemical-free paper towels before reuse. Wrap the equipment in tin foil and/or seal it in a plastic bag if it will not be reused for a while.

Dispose of soiled materials and spent solutions in the designated IDW disposal containers.

5.3 Decontamination for Inorganic (Metals) Analyses

This procedure applies to soil sampling equipment used primarily in the collection of environmental samples submitted for inorganic constituents analysis. Examples of relevant items of equipment include split-spoons, trowels, scoops/spoons, bailers, and other small items.

For plastic and glass sampling equipment, follow the steps outlined in 5.2 above, however, use a 10% nitric acid solution (acid in water) in place of the solvent rinse.

For metal sampling equipment, follow the steps outlined in 5.2 above, however, use a 10% hydrochloric acid solution (acid in water) in place of the solvent rinse.

5.4 Decontamination of Submersible Pumps

This procedure will be used to decontaminate submersible pumps before and between ground-water sample collection points. This procedure applies to both electric submersible and bladder pumps. This procedure also applies to discharge tubing if it will be reused between sampling points.

Prepare the decontamination area if pump decontamination will be conducted next to the sampling point. If decontamination will occur at another location, the pump and tubing may be removed from the well and placed into a clean trash bag for transport to the decontamination area. Pump decontamination is easier with the use of 3-foot tall pump cleaning cylinders (i.e., Nalgene cylinder) for the various cleaning solutions, although the standard bucket rinse equipment may be used.

Once the decontamination station is established, the pump should be removed from the well and the discharge tubing and power cord coiled by hand as the equipment is removed. If any of the equipment needs to be put down temporarily, place it on a plastic sheet (around well) or in a clean trash bag. If a disposable discharge line is used it should be removed and discarded at this time.

As a first step in the decontamination procedure, use a pressure sprayer with tap water to rinse the exterior of the pump, discharge line, and power cord as necessary. Collect the rinsate and handle as IDW.

Place the pump into a pump cleaning cylinder or bucket containing a detergent solution (detergent in tap water). Holding the tubing/power cord, pump solution through the pump system. A minimum of one gallon of detergent solution should be pumped through the system. Collect the rinsate and handle as IDW.

Place the pump into another cylinder/bucket containing a 10% solution of solvent (methanol, or other designated solvent) in distilled/deionized water. Pump until the detergent solution is removed. Collect the rinsate and handle as IDW.

Place the pump into another cylinder/bucket containing distilled/deionized water. Pump a minimum of 3 to 5 pump system volumes (pump and tubing) of water through the system. Collect the rinsate and handle as IDW.

Remove the pump from the cylinder/bucket and if the pump is reversible, place the pump in the reverse mode to discharge all removable water from the system. If the pump is not reversible the pump and discharge line should be drained by hand as much as possible. Collect the rinsate and handle as IDW.

Using a pressure sprayer with distilled/deionized water, rinse the exterior of the pump, discharge line, and power cord thoroughly, shake all excess water, then place the pump system into a clean trash bag for storage. If the pump system will not be used again right away, the pump itself should also be wrapped with aluminum foil before placing it into the bag.

5.5 Decontamination of Large Equipment

Consult the Work Plan for instruction on the location of the decontamination station and the method of containment of the wash solutions. On large projects usually a temporary decontamination facility (decontamination pad) is required which may include a membrane-lined and bermed area large enough to drive heavy equipment (drill rig, backhoe) onto with enough space to spread other equipment and to contain overspray. Usually a small sump with pump is necessary to collect and contain rinsate. A water supply and power source is also necessary to run steam cleaning and/or pressure washing equipment.

Upon arrival and prior to leaving a sampling site, all heavy equipment such as drill rigs, trucks, and backhoes should be thoroughly cleaned and then the parts of the equipment which come in contact or in close proximity to sampling activity should be decontaminated. This can be accomplished in two ways, steam cleaning or high pressure water wash and manual scrubbing. Following this initial cleaning, only those parts of the equipment which come in close proximity to the sampling activities (i.e., auger stems, rods, backhoe bucket) must be decontaminated in between sampling events.

Occasionally, well construction materials such as well screen and riser pipe may require decontamination before the well materials are used. These materials may be washed in the decontamination pad, preferably on a raised surface above the pad (i.e., on sawhorses), with clean plastic draped over the work surfaces. Well materials usually do not require a multistep cleaning process as they generally arrive clean from the manufacturer. Usually, a thorough steam-cleaning of the interior/exterior of the well materials will be sufficient. The Work Plan should provide specific guidance regarding decontamination of well materials.

6.0 Quality assurance / quality control

6.1 General Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific QAPP. The QAPP guidelines typically require collection of equipment blank samples in order to determine the effectiveness of the decontamination procedure.

The decontamination method, solvent, frequency, location on site and the method of containment and disposal of decontamination wash solids and solutions are dependent on site logistics, site-specific chemistry, and nature of the contaminated media to be studied and the objectives of the study. Each topic must be considered and addressed during development of a decontamination strategy and should be outlined in the Work Plan.

6.2 Solvent Selection

There are several factors which need to be considered when deciding upon a decontamination solvent. The solvent should not be an analyte of interest. The sampling equipment must be resistant to the solvent. The solvent must be evaporative or water soluble or preferably both. The applicable regulatory agency may have specific requirements regarding decontamination solvents. The QAPP should specify the type of solvent to be used for a particular project.

The analytical objectives of the study must also be considered when deciding upon a decontamination solvent. Pesticide-grade methanol is the solvent of choice for general organic analyses. It is relatively safe and effective. Hexane, acetone, and isopropanol are sometimes used as well. A 10% nitric acid in deionized water solution is the solvent of choice for general metals analyses. Nitric acid can be used only on Teflon, plastics and glass. If used on metal equipment, nitric acid will eventually corrode the metal and lead to the introduction of metals to the collected samples. Dilute hydrochloric acid is usually preferred over nitric acid when cleaning metal sampling equipment.

Equipment decontamination should be performed a safe distance away from the sampling area so as not to interfere with sampling activities but close enough to the sampling area to maintain an efficient working environment. If heavy equipment such as drill rigs or backhoes are to be decontaminated, then a central decontamination station should be constructed with access to a power source and water supply.

6.3 Field Blank Sample Collection

General guidelines for quality control check of field equipment decontamination usually require the collection of one field blank from the decontaminated equipment per day. The QAPP should specify the type and frequency of collection of each type of quality assurance sample.

Field blanks are generally made by pouring laboratory-supplied deionized water into, over, or through the freshly decontaminated sampling equipment and then transferring this water into a sample container. Field blanks should then be labeled as a sample and submitted to the laboratory to be analyzed for the same parameters as the associated sample. Field blank sample numbers, as well as collection method, time and location should be recorded in the field notebook.

7.0 Data and records management

Specific information regarding decontamination procedures should be documented in the project-specific field notebook. Documentation within the notebook should thoroughly describe the construction of each decontamination facility and the decontamination steps implemented in order to show compliance with the project work plan. Decontamination events should be logged when they occur with the following information documented:

- Date, time and location of each decontamination event
- Equipment decontaminated
- Method
- Solvents
- Noteable circumstances
- Identification of field blanks and decontamination rinsates
- Method of blank and rinsate collection
- Date, time and location of blank and rinsate collection
- Disposition of IDW

Repetitive decontamination of small items of equipment does not need to be logged each time the item is cleaned.

8.0 Personnel qualifications and training

All sampling technicians performing decontamination must be properly trained in the decontamination procedures employed, the project data quality objectives, health and safety procedures and the project QA procedures. Specific training or orientation will be provided for each project to ensure that personnel understand the special circumstances and requirements of that project. Field personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous materials may be present.

8.1 Sampling Technician

It is the responsibility of the sampling technician to be familiar with the decontamination procedures outlined within this POP and with specific quality assurance, and health and safety requirements outlined within project-specific Work Plan, HASP, and/or QAPP. The sampling technician is responsible for decontamination of field equipment and for proper documentation of decontamination activities. The sampling technician is also responsible for ensuring that decontamination procedures are followed by subcontractors when heavy equipment requires decontamination.

8.2 Field Project Manager

The field project manager is responsible for ensuring that the required decontamination procedures are followed at all times. The project manager is also responsible for ensuring that subcontractors construct and operate their decontamination facilities according to project specifications. The project manager is responsible for collection and control of IDW in accordance with project specifications.

9.0 References

Not applicable.

10.0 Revision History

Revision	Date	Changes
0	March 2010	Original POP

Project Operating Procedure

Packaging and Shipment of Environmental Samples

Procedure Number: 010

Revision No.: 0

Revision Date: March 2010

Date: March 2010

Robert Shoemaker, POP Author

Date: March 2010

Lucas Hellerich, Project Manager

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________

Initials: ________ Date: ________

Packaging and Shipment of Environmental Samples

Contents

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Project Operating Procedure

Packaging and Shipment of Environmental Samples

1.0 Project Scope and applicability

1.1 Purpose and Applicability

This Project Operating Procedure (POP) describes the procedures associated with the packaging and shipment of environmental samples. Two general categories of samples exist: environmental samples consisting of water and soil submitted for routine environmental testing, and waste material samples which include non-hazardous solid wastes and/or hazardous wastes as defined by 40 CFR Part 261 submitted for environmental testing or bench/pilot-scale treatability testing. Packaging and shipping procedures will differ for the two sample categories.

This POP is applicable to packaging and shipment of environmental samples submitted for routine environmental testing. Environmental samples are not considered a hazardous waste by definition; therefore, more stringent Department of Transportation (DOT) regulations regarding sample transportation do not apply. Environmental samples do, however, require fairly stringent packaging and shipping measures to ensure sample integrity as well as safety for those individuals handling and transporting the samples.

This POP is designed to provide a high degree of certainty that environmental samples will arrive at their destination intact. This POP assumes that samples will often require shipping overnight by a commercial carrier service, therefore, the procedures are more stringent than may be necessary if a laboratory courier is used or if samples are transported directly to their destination by a sampling team member. Should the latter occur, the procedures may be modified to reflect a lesser degree of packaging requirements.

Respective state or federal agency (regional offices) protocols may require or recommend specific types of equipment for use in sample packaging or a specific method of shipment that may vary from the indicated procedures. Deviations from this POP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the project work plan, and must be documented in the field project notebook when they occur.

1.2 General Principles

Sample packaging and shipment generally involves the placement of individual sample containers into a cooler or other similar shipping container and placement of packing materials and coolant in such a manner as to isolate the samples, maintain the required temperature, and to limit the potential for damage to sample containers when the cooler is transported.

2.0 Health and safety considerations

Sampling personnel should be aware that packaging and shipment of samples involves potential physical hazards primarily associated with handling of occasional broken sample containers and lifting of heavy objects. Adequate health and safety measures must be taken to protect sampling personnel from these potential hazards. The project Health and Safety Plan (HASP) generally addresses physical and other potential hazards. This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed. In the absence of a HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

Not Applicable

4.0 Equipment and materials

- Sample coolers
- Sample containers
- Shipping labels
- Chain-of-custody records, custody seals
- Bubble wrap
- Vermiculite (granular), or styrofoam pellets
- "Blue Ice" refreezable ice packs, or ice cubes
- Transparent tape, or rubber bands
- Fiber tape
- Duct tape
- Zipper-lock plastic bags
- Trash bags
- Health and Safety supplies
- Equipment decontamination materials
- Field project notebook/pen

5.0 Procedures

5.1 General Information

5.1.1 Regulatory Information

The extent and nature of sample containerization will be governed by the type of sample, and the most reasonable projection of the sample's hazardous nature and constituents. The EPA regulations (40 CFR Section 261.4(d)) specify that samples of solid waste, water, soil or air, collected for the sole purpose of testing, are exempt from regulation under the Resource Conservation and Recovery Act (RCRA) when any of the following conditions are applicable:

- Samples are being transported to a laboratory for analysis;
- Samples are being transported to the collector from the laboratory after analysis;
- Samples are being stored (1) by the collector prior to shipment for analyses, (2) by the analytical laboratory prior to analyses, (3) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

5.1.2 Sample Information:

The following information must accompany each shipment of samples on a chain-of-custody form (Figure 1) where each sample has an individual entry:

- Sample collector's name, mailing address and telephone number,
- Analytical laboratory's name, mailing address and telephone number,
- A unique identification of each sample,
- Sample description (matrix),
- Number and type of sample containers,
- Container size,
- Preservative,
- Type and method of analysis requested, and
- Date and time that the samples were collected and prepared for shipping,
- Special handling instructions, including notation of suspected high concentration samples.

5.1.3 Laboratory Notifications:

Prior to sample collection, the Project Manager, or designated alternative must notify the laboratory manager of the number, type and approximate collection and shipment dates for the samples. If the number, type or date of sample shipment changes due to program changes which may occur in the field, the Project Manager or alternate must notify the laboratory of the changes. Additional notification from the field is often necessary when shipments are scheduled for weekend delivery.

5.2 General Site Preparation

5.2.1 Small Projects

Small projects of one or two days duration may require packaging and shipment of samples using the field vehicle as the sample preparation area. If sample coolers will be sent via third party commercial carrier service, adequate sample packaging materials should be sent to the project location in advance of sampling or purchased from stores located near the site.

5.2.2 Large Projects

Multi-day or week sampling programs usually require rental of an office trailer or use of existing office/storage facilities for storage of equipment as well as for sample preparation. If possible, a designated area should be selected for storage of unused sample containers/coolers and another area for sample handling, packaging, and shipment. Handling of environmental samples should preferably be conducted in a clean area and away from unused sample containers to minimize the potential for cross contamination. Large quantities of packaging materials may require advance special ordering. Shipping forms/labels may be preprinted to facilitate shipping.

5.2.3 Cooler Inspection and Decontamination

Laboratories will often re-use coolers. Every cooler received at a project location should be inspected for condition and cleanliness. Any coolers that have cracked interior or exterior linings/panels or hinges should be discarded as their insulating properties are now compromised. Any coolers missing one or both handles should also be discarded if replacement handles (i.e., knotted rope handles) can not be fashioned in the field. Replacement coolers may be purchased in the field if necessary.

The interior and exterior of each cooler should be inspected for cleanliness before using it. Excess strapping tape and old shipping labels should be removed. If the cooler interior exhibits visible contamination or odors it should be decontaminated in accordance with POP 009 Decontamination of Field Equipment prior to use. Drain plugs should be sealed on the inside with duct tape.

5.2.4 Other Considerations

VOC Samples - Sample containers used for VOC analysis may be grouped into a single cooler, with separate chain-of-custody record, to limit the number of trip blanks required for transportation and analysis. Individual VOC samples may also be placed into Zipper-lock bags to further protect the samples.

Contaminated Samples - Sample containers with presumed high contaminant concentrations should be isolated within their own cooler with each sample container placed into a Zipper-lock bag.

5.3 Sample Packaging Method

Sample packaging should be conducted in the following manner:

Place plastic bubble wrap matting over the base of each cooler or shipping container as needed. A 2- to 3-inch thickness layer of vermiculite may be used as a substitute base material.

Insert a clean trash bag into the cooler to serve as a liner.

Check that each sample container is sealed, labeled legibly, and is externally clean. Re-label and/or wipe bottles clean if necessary. Clear tape should be placed over the labels to protect them. Wrap each sample bottle individually with bubble wrap secured with tape or rubber bands. Place bottles into the cooler in an upright single layer with approximately one inch of space between each bottle. Do not stack bottles or place them in the cooler lying on their side. If plastic and glass sample containers are used, alternate the placement of each type of container within the cooler so that glass bottles are not placed side by side.

Insert cooler temperature blanks if required.

Place additional vermiculite, bubble wrap, and/or styrofoam pellet packing material throughout the voids between sample containers within each cooler to a level which meets the approximate top of the sample containers. Packing material may require tamping by hand to reduce the potential for settling.

Place cubed ice or cold packs in heavy duty Zip-lock type plastic bags, close the bags, and distribute the packages in a layer over the top of the samples. Cubed ice should be double-bagged to prevent leakage. Loose ice should never be used. Cold packs should be used only if the samples are chilled before being placed in the cooler.

Add additional bubble wrap/styrofoam pellets or other packing materials to fill the balance of the cooler or container.

Obtain two pieces of chain of custody tape as shown in Figure 2 and enter the custody tape numbers in the appropriate place on the chain-of-custody form. Sign and date the chain-of-custody tape.

Complete the chain-of-custody form. If shipping the samples involves use of a third party commercial carrier service, sign the chain-of-custody record thereby relinquishing custody of the samples. Shippers should not be asked to sign chain of custody records. If a laboratory courier is used, or if samples are transported to the laboratory, the receiving party should accept custody and sign the chain-of-custody records. Remove the last copy from the form and retain it with other field notes. Place the original (with remaining copies) in a Zipper-lock type plastic bag and tape the bag to the inside lid of the cooler or shipping container.

Close the top or lid of the cooler or shipping container.

Place the chain of custody tape at two different locations (i.e., one tape on each side) on the cooler or container lid and overlap with transparent packaging tape.

Packaging tape should be placed entirely around the sample shipment containers. A minimum of two full wraps of packaging tape will be placed at least two places on the cooler.

Repeat the above steps for each cooler or shipping container.

5.4 Sample Shipping Method

Packaged sample coolers should be shipped using one of the following options:

5.4.1 Hand Delivery

When a project member is transporting samples by automobile to the laboratory, the cooler should only be sealed with tape. In these cases, chain-of-custody will be maintained by the person transporting the sample and chain-of-custody tape need not be used. Chain-of-custody records should be relinquished upon delivery and a copy of the record retained in the project file.

5.4.2 Laboratory Courier

Laboratory couriers are usually employees of the analytical laboratory receiving the samples. As such, they will accept custody of the samples and must be asked to sign the chain-of-custody records. Chain-of-custody records do not need to be sealed in the cooler although it is recommended that the coolers be sealed with tape. All other packaging requirements generally apply unless otherwise specified in the SAP.

If the laboratory courier is not authorized to accept custody of the samples, or if the requirements of the project plan preclude transfer to the laboratory courier, samples will be handled as described below in Section 5.4.3.

5.4.3 Third Party Courier

If overnight shipment is required, a third party package delivery service should be used. Transport the cooler to the package delivery service office or arrange for package pick-up at the site. Fill out the appropriate shipping form or airbill and affix it to the cooler. Some courier services may use multi-package shipping forms where only one form needs to be filled out for all packages going to the same destination. If not, a separate shipping form should be used for each cooler. Keep the receipt for package tracking purposes should a package become lost. Please note that each cooler also requires a shipping label which indicates point of origin and destination. This will aid in recovery of a lost cooler if a shipping form gets misplaced. Never leave coolers unattended while waiting for package pick-up. Airbills or waybills will be maintained as part of the custody documentation.

5.5 Sample Receipt

Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain-of-custody form. The laboratory will verify that the chain-of-custody tape has not been broken previously and that the tape number corresponds with the number on the chain-of-custody record. The laboratory will note the condition of the samples upon receipt and will identify any discrepancies between the contents of the cooler and chain-of-custody. The analytical laboratory will then forward the back copy of the chain-of-custody record to the project manager to indicate that sample transmittal is complete.

6.0 Quality assurance / quality control

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific work plan or QAPP. Proper quality assurance requirements should be provided which will specify sample packaging and shipment requirements if variations to the indicated procedures are necessary on a particular project.

The potential for samples to break during transport increases greatly if individual containers are not snugly packed into the cooler. Completed coolers may be lightly shake-tested to check for any loose bottles. The cooler should be repacked if loose bottles are detected.

Environmental samples are generally shipped so that the samples are maintained at a temperature of approximately 4°C. Temperature blanks may be required for some projects as a quality assurance check on shipping temperature conditions. These blanks usually are supplied by the laboratory and consist of a 40-ml vial or plastic bottle filled with tap water. Temperature blanks should be placed near the center of the cooler.

7.0 Data and records management

Documentation supporting sample packaging and shipment generally consists of chain-of-custody records and shipping records. In addition, a description of sample packaging procedures will be written in the field project notebook. All documentation will be retained in the project files following project completion.

8.0 Personnel qualifications and training

Sample packaging and shipment is a relatively simple procedure requiring minimal training and a minimal amount of equipment. It is, however, recommended that initial attempts be supervised by more experienced personnel. Sampling technicians should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous waste materials are considered to be present.

8.1 Sampling Technician

It is the responsibility of the sampling technician to be familiar with the procedures outlined within this POP and with specific sampling, quality assurance, and health and safety requirements outlined within the project-specific plans. The sampling technician is responsible for proper packaging and shipment of environmental samples and for proper documentation of sampling activities for the duration of the sampling program.

8.2 Sampling Coordinator

Large sampling programs may require additional support personnel such as a sampling coordinator. The sampling coordinator is responsible for providing management support such as maintaining an orderly sampling process, providing instructions to sampling technicians regarding sampling locations, and fulfilling sample documentation requirements, thereby allowing sampling technicians to collect samples in an efficient manner.

8.3 Project Manager

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the activities in accordance with the project plan and this POP. The project manager is also responsible for ensuring that proper arrangements have been made with the designated analytical laboratory. These arrangements include, but are not necessarily limited to, subcontractor agreements, analytical scheduling, and bottle/cooler orders. The project manager may delegate some of these responsibilities to other project staff.

9.0 References

Not applicable.

10.0 Revision History

Revision	Date	Changes
0	March 2010	Original POP

Figure 1. Chain of Custody Form

AECOM

CHAIN OF CUSTODY RECORD

Page ____ of ____

Client/Project Name: | Project Location:

Project Number: | Field Logbook No.:

Sampler (Print Name)/(Affiliation): | Chain of Custody Tape Nos.:

Signature: | Send Results/Report to: | TAT:

Analysis Requested

Container Type
P – Plastic
A – Amber Glass
G – Clear Glass
V – VOA Vial
O – Other
E – Encore

Preservation
1 – HCl, 4°
2 – H2SO4, 4°
3 – HNO3, 4°
4 – NaOH, 4°
5 – NaOH/ZnAc, 4°
6 – Na2S2O3, 4°
7 – 4°

Matrix Codes:
DW – Drinking Water
WW – Wastewater
GW – Groundwater
SW – Surface Water
ST – Storm Water
W – Water
S – Soil
SL – Sludge
SD – Sediment
SO – Solid
A – Air
L – Liquid
P – Product

Field Sample No./Identification	Date	Time	COMP	GRAB	Sample Container (Size/Mat'l)	Matrix	Preserv.	Field Filtered											Lab I.D.	Remarks

Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	Analytical Laboratory (Destination):
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	Sample Shipped Via: UPS FedEx Courier Other | Temp blank Yes No

Serial No. ____________

Figure 2. Chain of Custody Tape

№

Signature ______________________________

Date ______________________________

AECOM

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Self Implementing PCBs Decontamination of Equipment – TSCA § 761.79

Decontamination of PCB containers includes solvent and/or pressure wash with triple rinse. Each flush should use a volume equal to approximately 10% of container size. Decontamination wastes shall be contained and collected for disposal.

Decontamination methods for movable equipment, such as a backhoe, include the triple wash/rinse option. Assuming the equipment contains dirt, dust and/or grease on surfaces, the following procedure should be followed:

1. First wash – Cover entire area with concentrated or industrial strength detergent. Scrub surface with brush or pad such that each one square foot area is scrubbed for one minute. Additional cleaning solution shall be applied during scrubbing such that area is very wet. Contain and collect all cleaning solutions.
2. First rinse – Rinse surface with one gallon water per square foot of surface area. Contain and collect all rinsate.
3. Second wash – Cover entire area with organic solvent. Scrub surface with brush or pad such that surface is scrubbed for one minute. Keep surface very wet during wash. Collect and contain all cleaning solutions.
4. Second rinse – Wet surface with water for one minute. Collect and contain all rinsate.
5. Third wash – Repeat step 3.
6. Third rinse – Repeat step 4. Wipe surfaces dry using clean, dry absorbent pad.

Solubility of PCBs in solvent shall five percent or more by weight. Contractor shall take precautions to guard against decontamination fluid releases. Appropriate PPE is to be employed. Containerized decontamination liquid wastes shall be disposed of at their existing PCB concentration. PPE can either be decontaminated or disposed at approved facility.

A written record documenting compliance shall be kept for three years after decontamination has been completed.

AECOM	SH&E No.:	713
	Rev:	Original
Confined Spaces **AECOM Safety, Health and Environmental Procedure**	Date:	October 5, 2009

1.0 PURPOSE

Establishes requirements for AECOM employees to participate in entries into confined spaces.

2.0 SCOPE

This procedure applies to all AECOM U.S.-based employees and operations.

3.0 DEFINITIONS

Asphyxiant – An airborne substance which can cause suffocation. Simple asphyxiants (e.g., carbon dioxide, nitrogen, argon, etc.) physically displace oxygen from the atmosphere while chemical asphyxiants (e.g., carbon monoxide, hydrogen cyanide, etc.) prevent the body from utilizing oxygen in the atmosphere.

Attendant – An individual who is stationed **outside** of a permit-required confined space to monitor the authorized entrants and to initiate emergency response if necessary.

Class 1, Division 1 Approved – Approval given to equipment which has been approved for use in atmospheres which are known to contain flammable gases and vapors.

Confined Space – A space which:

- Is large enough and so configured that an employee can physically enter and perform assigned work;
- Has limited or restricted means for entry or exit; and,
- Is not designed for continuous human occupancy.

Entrant – An employee who is authorized to enter a permit-required confined space.

Entry – The action by which a person passes through an opening into a confined space. Entry is considered to have occurred as soon as any part of the body breaks the opening of a confined space.

Entry Permit – A written or printed document that controls entry into a permit-required confined space.

Entry Supervisor – An employee responsible for determining if acceptable entry conditions are present, for authorizing entry into a permit-required confined space, overseeing entry operations and for terminating entry.

Hazardous Atmosphere – An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue, injury, or acute illness from one or more of the following:

- Oxygen concentrations below 19.5%
- Flammable atmospheres (concentrations > 10% of the lower explosive limit)
- Toxic environments (concentrations > than the permissible exposure limit)

Non-Permit Required Confined Spaces (NPRCS) – Spaces that do not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm. These spaces do not require specific entry procedures.

Hot Work – Any task which may produce a spark or source of ignition (e.g., welding, cutting, etc.) in areas potentially containing flammable gases or vapor.

Immediately Dangerous to Life or Health (IDLH) – The exposure limit established by the National Institute for Occupational Safety and Health (NIOSH) which refers to the airborne concentration of a substance which can cause death, serious or irreversible health consequences, or inability to escape within 30 minutes.

Inerting – Displacement of the atmosphere by a nonreactive gas (such as nitrogen) to such an extent that the resulting atmosphere is nonflammable.

Lower Explosive Limit (LEL) – The lowest concentration of a flammable gas/vapor in air which will ignite.

Oxygen Deficiency – An atmosphere with an oxygen concentration less than 19.5%. Normal air contains approximately 21% oxygen. Any atmosphere containing less than 19.5% oxygen shall be considered IDLH (immediately dangerous to life and health).

Permit-Required Confined Space (PRCS) – A confined space that exhibits one or more of the following properties:

- Contains or has a potential to contain a hazardous atmosphere;
- Contains a material that has the potential for engulfing an entrant;
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- Contains any other recognized serious safety or health hazard.

Physical Hazard – A non-chemical hazard which may cause cuts, abrasions, crushing, trauma, hearing loss, burns, or radiant energy effects (e.g., welding).

Upper Explosive Limit (UEL) – The highest concentration of a flammable gas/vapor in air which will ignite.

4.0 ROLES AND RESPONSIBILITIES

4.1 REGIONAL AND DISTRICT OPERATIONS MANAGERS

- Provide Confined Space training to employees engaged in projects covered by this Procedure.
- Assure that Project Managers are implementing confined space entry procedures on their projects where applicable.

4.2 PROJECT MANAGER/FIELD TASK MANAGER

Project/Lead Manager or Resident Engineer on the project is responsible for administering the procedure including:

- Determining alternative procedures that eliminate the need for entering confined spaces
- Consulting with the SH&E regarding project specific requirements for confined space entries
- Informing the field team about the client or facility's requirements for confined space entries
- Ensuring that only trained, authorized employees work in or near confined spaces
- Assuring that each written Confined Space Entry Procedure and permits are prepared for each entry
- Assign an Entry Supervisor to be in control of all activities associated with the confined space
- Assure that air monitoring instruments are rented from an approved vendor or industrial hygiene consultant and calibrated in accordance with the manufacturer's requirements.

4.3 ENTRY SUPERVISOR

- Assess the risks prior to entry and establish the work plan accordingly
- Notify the SH&E Department prior to entry into a confined space to review the planned activity, circumstances and Confined Space Permit
- Verify what conditions exist

- Verify that all participants (entrants and attendant) are trained
- Conduct a tailgate training session at the location of the confined space reviewing all entries in the Permit with all attendants and entrants.
- Assure that the air within the confined space is tested with an appropriated air monitoring instrument.
- Assure that all air test results are documented on the Permit form.
- Verify that a rescue team, equipped with retrieval equipment and trained in confined space entry rescue is available. A rescue team may be the local Fire Department or a client's Emergency Rescue Squad or the construction project's emergency response team. Emergency rescue capability must be established in the permit process including the emergency contact numbers.
- Notify the emergency rescue service prior to an entry of the time, location and duration of work in a confined space.
- Confirm that appropriate means of communication are assured (in place and operable) for the entry team. Communication can be verbal, hand signals, radio or telephone.
- Confirm that the proper isolation of any process lines, pipes or electrical systems that can affect safety or health of entrants in a confined space are isolated and secure e.g., blanking, blocking, lockout-tagout and verifying that systems are isolated prior to proceeding with work.
- Verify that fresh air ports, manways and accessways are opened during the entire operation.
- Ensure that fresh air is continuously forced into the confined space prior to and during work within a permit required confined space. Exhausting air from a space lends to the risk of drawing contaminated air from elsewhere into the space. The source of fresh air should always be checked. The objective is that the forced air is sufficient to maintain a permit space safe for entry.
- Ensure that appropriate safety equipment is selected and used by all entrants based on the physical and health hazards that may exist.

The entry supervisor may also serve as the outside attendant.

4.4 DUTIES OF THE ATTENDANT

The attendant must remain outside the confined space at all times. The attendant must not leave the post unattended at any time. If the attendant needs to leave his position, entrants must be called out of the confined space or another qualified attendant must take the position and responsibility.

The attendant is responsible for following the Confined Space Permit and shall:

- Confirm that correct names of all entrants are listed on the permit.
- Ensure that all applicable parts of the permit are completed before allowing any AECOM employee to enter the space.
- Ensure that all equipment going into the confined space is in safe operating condition, e.g., tools and protective equipment. It is prohibited for compressed gas bottles (e.g., burning and welding) to be brought into a confined space. All gas lines brought into accessways shall be protected from sharp edges.
- Ensure that all entrants have received any special instructions for the work to be performed before entering into the space.
- Maintain assured and ongoing contact with entrants either visually, verbally, or the use of hand signals or radio.
- Interrupt work and call out any/all entrants in the event of a newly developed dangerous condition, when signs of entrant stress or fatigue are noticed, or when the attendant needs to leave the post and cannot be replaced by another attendant.
- Summon rescue and other services during an emergency.
- Warn any unauthorized persons not to enter a Permit Confined Space.

4.5 ENTRANTS

- Know the emergency action plan and be able to recognize the potential for real hazards associated with the Confined Space. Refer to the Permit and ask the Supervisor or Regional SH&E Manager if a question arises.
- Know how to use the identified personal protective equipment required for entry or rescue.
- In the event of coming upon anyone down and unconscious within a confined space, the first response for anyone including the attendant is to withdraw from the space immediately and send the alert for emergency response. (Most fatalities in confined spaces involve workers who attempt to rescue other workers without the correct equipment and training).
- Know how to exit the confined space as rapidly as possible without help whenever:
  - The attendant orders an evacuation.
  - Any alarm from a continuous monitor/detector sounds.
  - The entrant(s) recognizes the warning signs of exposure to hazardous substances that could be found in that confined space.
- Be aware of the toxic effects or symptoms of the hazardous materials that could be encountered in the confined space.
- Know how to relay an alarm to the outside attendant and to attempt self-rescue immediately upon becoming aware of hazardous conditions.
- Know any modification of normal work practices that are necessary for permit required confined space work.

4.6 ALL EMPLOYEES

- Refrain from making any attempt to enter a confined space without first meeting the requirements of this Procedure
- Avoid areas where other employees are working in confined spaces

5.0 PROCEDURE

5.1 CONFINED SPACES

All confined spaces under the control of AECOM or that may be entered by AECOM employees will be identified, evaluated and classified on a Confined Space Inventory Listing (Attachment 1 or equivalent). The inventory listing shall be updated as required, at a minimum annually. An inventory shall be prepared for each project site containing confined spaces to which AECOM employees are exposed.

5.1.1 Labeling

All permit-required confined spaces under AECOM control will be labeled so that employees are adequately warned of the potential for hazardous conditions. Labeling is not required under the following circumstance:

- The spaces are easily recognizable, numerous, and widely-spaced (e.g., storm sewer manholes). Employees will be instructed that these constitute confined spaces during required training. However, these locations will be included on the inventory.
- A complete inventory has been developed, all personnel have been trained in the use of the inventory, and the workers consult the inventory prior to performance of any work that may require entry into a confined space.

When non-permit-required confined spaces require the implementation of confined space entry procedures because of specific work operations (e.g., painting, welding), all entry points will be labeled or identified by signs to alert all employees of the existence of the hazardous conditions. These labels or signs will be removed only when the hazard no longer exists (e.g., complete curing of the paint).

5.1.2 Classification of Confined Spaces

For each identified confined space, an evaluation to determine the nature and extent of all possible hazards to entrants must be conducted. Consideration will be given to the following types of hazards:

- The presence of possible airborne contaminants at concentrations exceeding established occupational exposure limits (PELs)
- The presence of any physical hazards (e.g., electrical shock, mechanical injury, etc.)
- The presence of flammable or explosive conditions
- The presence of any potential for rapid flooding or engulfment
- Configurations/positioning that may cause an entrant to become trapped
- Initial classification as either a PRCS or NPRCS

The evaluation will be documented using the Confined Space Hazard Assessment form found in Attachment 2. A copy of this evaluation will be maintained in the project files.

Wherever the confined space is controlled by a client or third-party, the controlling entity should be contacted to provide the information necessary to complete the evaluation. However, if AECOM personnel are required to enter a confined space owned or controlled by others, the final evaluation will remain the responsibility of responsible AECOM manager.

Non-permit-required confined spaces can be designated only by a Certified Industrial Hygienist, Certified Safety Professional, AECOM Regional SH&E Manager or Professional Engineer after review of the space(s), historical monitoring data, and other factors (e.g., injuries that have occurred). Therefore, all confined spaces will be considered permit-required unless specifically designated as a non-permit space, in writing, on the approved confined space inventory listing.

5.2 PRCS-SPECIFIC ENTRY PROCEDURES

To protect employees during PRCS entries, and to meet the requirements of 29 CFR 1910.146, AECOM-specific PRCS entry procedures will be developed for each PRCS to be entered. Each entry procedure will detail:

- The identity of the PRCS(s) to which the procedure applies;
- Details concerning the potential hazards associated with the entry operation/PRCS;
- Pre-entry preparation:
- Required air monitoring equipment;
- Required emergency response/extraction equipment;
- Required ventilation procedures (as applicable);
- Required isolation procedures (as applicable);
- Rescue agency notification requirements (as applicable);
- Required pre-entry monitoring procedures and applicable at-entry re-classification criteria
- Air monitoring procedures during entry (if re-classification has not occurred);
- PPE requirements during entry.

Specific entry procedures can be documented by following the procedures in sections 5.3 through 5.6 of this procedure and by completing a Job Safety Analysis in combination with a completed Confined Space Hazard Analysis and Confined Space Permit.

5.3 PRCS PRE-ENTRY PROCEDURE:

Prior to the start of the entry operation, the Entry Supervisor will assign individuals on the entry team to the following jobs:

- Entrant – The person entering the PRCS
- Primary Attendant - The person dedicated only to assisting the entrant, observing the entry operation and maintaining communications with the entrant throughout the entry procedure.
- Secondary Attendant for Rescue Procedures – An additional employee may be assigned either to specific support of the entry operation or working nearby who can assist with rescue operations in the event of an accident. This person can perform other duties unrelated to observing the entry.

The Entry Supervisor is responsible for ensuring that the individuals assigned to each job fully understand their duties and responsibilities prior to initiating the entry operation. The Entry Supervisor will review the complete entry procedure with all team members prior to the work. The Entry Supervisor will also verify the availability of rescue services.

Additional requirements for Pre-Entry Planning include the following:

- Select the appropriate equipment to measure the potential hazards. Select a multi-gas meter capable of measuring oxygen, combustible gas (%LEL), and other Hazardous Gases.
- Determine the acceptable values for the hazardous conditions being measured, based on the equipment in use and the field calibration method. The action levels are determined as follows:

  Oxygen - 19.5% - 23.5%

  Lower explosion limit - 10%

  Hydrogen sulfide - 5 ppm

  Carbon monoxide - 15 ppm

  Other toxic chemicals - Contact Health and Safety Department

  Ensure all the equipment selected is calibrated, and calibration is still valid.

Personnel trained in accordance with this procedure shall perform field verification of equipment as follows:

- Calibrate combustible gas meters using appropriate span gas for the detectors to be used. (This span gas calibration shall be performed each time the instrument is turned on).
- Check detector tube pumps for leakage using the manufacturer's procedures.
- Calibrate Photo ionization detectors (PID) using isobutylene, or other material, in accordance with the manufacturer's directions.
- Calibrate any other instrumentation to be used in accordance with manufacturer's directions.
- Set up barricades around the space being entered as required.
- Set up required rescue or retrieval systems.
- Institute required lockout/tagout procedures (i.e. electrical, steam, liquid flow-pipe blanking)
- Ensure that a second person (trained as entry attendant) is available and assists in the set up procedures.
- Agree upon a means of communication between the entrant and the attendant. (The attendant is not authorized to perform rescue involving entry into the space, unless he/she is trained for rescue and another entry attendant replaces him/her prior to the attempt to rescue).
- Verify a means to contact emergency rescue services for further assistance.
- Complete Confined Space Entry Permit.

The Entry Supervisor shall also:

- Have the attendant verify the completion of the required actions.
- Entry supervisor shall sign the Permit upon verification of completed actions.
- Maintain the Permit at all authorized entry sites until completion of the entry.

5.4 PRCS ENTRY PERMITS

A PRCS Entry Permit is required to be completed for each individual PRCS entry operation (Exception: Multiple entries of an individual PRCS during a single work shift can be covered by a single Permit). The Permit provides the means for documenting:

- The identities and roles of all individuals involved in the entry operation.
- Equipment used for performance of the entry (monitoring instruments, extraction equipment, etc.).
- Pre-entry and operational monitoring results.
- Communications protocols between Entrants, Attendants, and rescue services.
- Lockout/Tagout procedures
- PPE for specific tasks (refer to the JSA for the task)
- Other relevant workplace conditions or events related to the entry operation (e.g., vault isolation procedures).

The Permit also provides the documented basis for re-classification of any PRCS as non-permit required (for purposes of the particular entry operation) based upon pre-entry monitoring procedures. Each Permit will be signed and authorized by the Entry Supervisor. At the completion of the entry operation, the Permit will be filed as part of the project records.

A copy of AECOM's PRCS Entry Permit form is provided in Attachment 3 and an example of AECOM's Confined Space Entry Classification Guidance is provided in Attachment 4.

5.5 PRCS ENTRY PROCEDURE

- Check the area around the seal to ensure that no flammable situations exist prior to door or cover removal. Note: Always check for oxygen levels first if the meter does not measure simultaneously. Low oxygen levels can cause LEL readings to be incorrect.
- Don any required PPE.
- Carefully remove any access doors or covers.
- Upon removal of the access cover/door, check the immediate atmosphere using remote testing procedures to ensure the immediate atmosphere is safe. If any of the parameters being tested are outside the action level, do not enter.
- If necessary, use exhaust ventilation to either remove the contaminant(s) or to correct the oxygen-deficient atmosphere.
- If the initial test(s) are within allowable ranges, slowly enter the space, continually testing the atmosphere in front and to the sides.
- In stratified atmospheres (i.e., vertical entries), testing will be done 4 feet in advance of the direction of travel. Travel speed will allow for adequate instrument response time.
- The entire area where work is to be performed will be tested prior to performance of any work.
- While performing the work, place the direct read instruments in a location that will not interfere with the work, allow for continual monitoring, and allow for noting any alarms that may be activated.
- Upon work completion, pick up all equipment and leave the space.

5.6 PRCS EXIT PROCEDURE

- Replace all access covers.
- Ensure all signs are visible and legible.
- Remove all lockout/tagout equipment.
- Note on the Permit any problems encountered while in the space.

- Finish the Permit and turn it in to the Entrant Supervisor.
- The Entrant Supervisor will inspect the Permit for completion and investigate any noted problems. Actions taken to correct noted problems will be discussed with all authorized entrants and attendants for future implementation.
- The completed Permit will be maintained on file as required in this section.

5.7 NON-PERMIT REQUIRED CONFINED SPACE ENTRY PROCEDURE

Persons entering this type of space only need to complete a confined space entry permit and remain vigilant about conditions in the space and remember that if any condition changes or if hazards are introduced into the space (e.g. welding/cutting operations), the classification and entry procedures in the space may change.

5.7.1 NPCS Entry Procedure

- When entrance covers are removed, guard the opening to prevent an accidental fall through the opening and to protect each employee working in the space from foreign objects entering the space.
- Check the atmosphere with the gas detector for Oxygen, LEL and other Hazardous gases (e.g. CH_4, H_2S, and CO) in the same order prior to entry into the space.
- Record the measured conditions on the permit and do not allow entry if detected levels are above action levels.
- Proceed with entry and work with caution.

5.7.2 NPCS Post Entry Procedures

The following post-entry procedures must be followed after the completion of a non-permit required confined space entry:

- Replace all access covers.
- Ensure all signs are visible and legible.
- Remove all lockout/tagout equipment, if applicable
- Note any problems encountered while in the space on the Permit.
- Finish the Permit, and turn in to the entrant supervisor.
- The entrant supervisor shall inspect the Permit for completion, and investigate any noted problems. Actions taken to correct noted problems shall be discussed with all authorized entrants and attendants for future implementation.
- The completed Permit shall be maintained in record for annual review.

5.8 ALTERNATE ENTRY PROCEDURES

Under certain conditions, alternative entry procedures may be used. The SH&E Department representative may prescribe alternate procedures if justified.

5.9 RESCUE SERVICES

5.9.1 Outside Rescue Service (including client services)

- Prior to authorizing entry into any confined space, Project Manager should:
- Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner (within 3 minutes for life threatening situations or 15 minutes for non-life threatening injuries), considering the hazard(s) identified;
- Evaluate a prospective rescue service's ability.
- Select a rescue team or service from those evaluated that:

- Has the capability to reach the victim(s) within a timeframe that is appropriate for the permit space hazard(s) identified [as defined in 4.4 (1) above];
- Is equipped for and proficient in performing the needed rescue services;
- Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and
- Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

5.9.2 AECOM Rescue Service

Prior to authorizing entry into any confined space, Project Manager should:

- Provide affected employees the required personal protective equipment (PPE) and train them in its use;
- Train affected employees to perform assigned rescue duties;
- Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR) (at least one member shall hold a current certification in first aid and CPR); and
- Ensure that affected employees practice making permit space rescues at least once every 12 months.

5.9.3 Facilitating Non-Entry Rescue

- Retrieval systems or methods shall be used whenever an authorized entrant enters a permit space (unless the retrieval equipment would increase the overall risk of entry).
- Retrieval systems shall meet the following requirements:
  - Each authorized entrant shall use a chest or full body harness with a retrieval line attached at the center of the entrant's back near shoulder level or other suitable locations as appropriate.
  - The other end of the retrieval line shall be attached to a mechanical device (mandatory for more than 5 feet deep rescue) or fixed point outside the permit space.

6.0 REFERENCE MATERIAL

29 CFR 1910.146 – *Permit Required Confined Spaces*

29 CFR 1910.147 – *Control of Hazardous Energy (Lockout-Tagout)*

7.0 ATTACHMENTS

Attachment 1 – Confined Space Identification Log

Attachment 2 – Confined Space Hazard Assessment Form

Attachment 3 – Confined Space Entry Permit Form

Attachment 4 – Confined Space Entry Classification Guidance

8.0 REVISION HISTORY

Revision	Date	Change
Original	October 5, 2009	N/A
Revision 1		

ATTACHMENT 1: CONFINED SPACE IDENTIFICATION LOG

Name of Space and Location	Permit Required Confined Space		Alternate Procedure Confined Space		Non-Permit Required Confined Space	
	Y	Initial Date Inventoried	Y	Date Reclassified	Y	Date Reclassified

Attachment 2: Confined Space Hazard Assessment Form

PART 1. CONFINED SPACE IDENTIFICATION
Confined Space Name:
Dimensions:
Description of Space:
Is this space entered on a routine basis? ☐ Yes ☐ No
Described Tasks and Frequency:
PART II. NATURE OF THE HAZARDS – ASSUMPTIONS: Tanks are empty and clean, all energy sources identified and isolated, and no other hazards are introduced into the spaces. A more formal hazard assessment must be done at time of entry.

Potential Atmospheric Hazards	**Potential Non-Atmospheric Hazards**
☐ O_2 Deficient /Enriched	☐ Contains Material Which Could Engulf Entrant?__________
☐ Combustibles/Flammables	☐ Internal Config. Could Trap Entrant?__________
☐ CO	☐ Electrical (live circuits)? __________
☐ H_2S	☐ Mechanical (pipes, linkages)?__________
☐ Other Toxics	☐ Slick/Residue Covered Surfaces?__________
	☐ Equipment Preventing Safe Exit?__________
	☐ Low/Inadequate Lighting?__________
	☐ Hazardous Chemicals Present? __________
	☐ Fall Potential?__________
	☐ Potential for Dropped Objects?__________
	☐ Multiple Work Groups/Nature of Work__________
	☐ Other __________

Photo of Space Here...

Attachment 3: PRCS Entry Permit Form

1. Permit space to be entered:__________________ Project Name & No.:__________________________________
2. Purpose of entry:____
3. Good on this date only:_________ From:_______________AM/PM To:_______________AM/PM

Authorized Entrants: Authorized Attendants: Entry Supervisor:

______________________ ______________________ __________________

______________________ ______________________ __________________

______________________ ______________________ __________________

5. Hazards within the permit space:____

____

____

6. Permit Space Preparation

1. Work area isolated with signs/barriers? __________Yes__________No
2. All energy sources locked/tagged out? __________Yes__________No
3. All input lines capped/blinded? __________Yes__________No
4. Permit Space contents drained/flushed/neutralized? __________Yes__________No
5. Permit Space cleaned/purged? __________Yes__________No
6. Ventilation provided 30 minutes before entry? __________Yes__________No

7. Initial atmospheric testing

	Reading	Time	Acceptable level
Oxygen %	_______	_______	_____________
LEL	_______	_______	_____________
Other Contaminants	_______	_______	_____________
Other Contaminants	_______	_______	_____________
Other Contaminants	_______	_______	_____________

8.

Test (s) To Be Taken	Permissible Entry Levels	Test 1	Test 2	Test 3	Test 4
A. Percent Oxygen	19.5% to 23.5%				
B. Explosivity	<10% LEL				
C.					
D.					
E.					
Name of Tester					
Test Times					

AECOM

9. Rescue Services (circle one) On Site Off Site

Phone # for Rescue Services or means of summoning:

____

____

10. Communication devices and procedures to be used during entry:

____

____

11. Safety Equipment required for entry:

PPE N/A ( ) YES ( ) Specify____

Testing Equipment N/A ( ) YES ( ) Specify____

Alarm System N/A ( ) YES ( ) Specify____

Rescue Equipment N/A ( ) YES ( ) Specify____

Other N/A ( ) YES ( ) Specify____

12. Additional Permits Required:

Hot work: ☐ Yes ☐ No

Other: ☐ Yes ☐ No

13. Permit Authorization:

I certify that I have inspected the work area for safety and reviewed all safety precautions recorded on this permit.

Permit Authorization by entry Supervisor (Signature): _______________ Date/Time_______________

14. Permit Conditions Verification:

Physical conditions at confined space checked and verified to be in accordance with the permit ☐ Yes ☐ No

If no; please record the deviation observed and corrective action taken:

____

____

____

Verified by : __________________________ ________________ _________________

(Entry Supervisor) Date Time

15. Review & Close-out:

Please list problems encountered during entry:

____

____

____

Corrective / Preventive Action Taken:

____

____

____

Additional Precautions / Recommendation for Future Entry:

____

____

____

Based on this review, this confined space shall be considered:

- Permit Required Confined Space ☐ Yes ☐ No
- Non-Permit Required Confined Space ☐ Yes ☐ No
- Alternate Procedure Confined Space ☐ Yes ☐ No

Reviewed By:_________________________ _______________ _______________

(Entry Supervisor) Date Time

ATTACHMENT 4

Confined Space Entry Classification Guidance

Facility Name Here

						METER READINGS					
Confined Space Name	Confined Space Location	Task Description	Permit required confined space	Enter By Alternate Procedure	Enter Following Non Permit Procedure	O2	LEL	H2S	CO	Entry rescue	Non entry rescue